STDN NO. 502.2

(STDN-502.2-Rev-3) STDN NETWORK OPERATIONS PROCEDURES FOR TELEMETRY SYSTEMS, REVISION 3 (NASA) 490 p

N82-72814

Unclas
00/17 13994

STDN
NETWORK OPERATIONS PROCEDURES
FOR
TELEMETRY SYSTEMS

REVISION 3

OCTOBER 1977

GSFC

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

STDN

NETWORK OPERATIONS PROCEDURES

FOR

TELEMETRY SYSTEMS

Revision 3

October 1977

Approved by: Warren Jackson

Warren Jackson,
Data Systems Section

Revision 3 to STDN No. 502.2 supersedes the previous change and revision. Destroy outdated pages.

GODDARD SPACE FLIGHT CENTER

Greenbelt, Maryland

CHANGE INFORMATION

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5-13/5-14	Rev 3
5-15 and 5-16	Rev 3
5-17/5-18	Rev 3
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5-43 and 5-44	DCN 017
5-44A/5-44B	DCN 017
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5-47 and 5-48	DCN 017
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5-55/5-56	DCN 008
6-1	Rev 3
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6-5 thru 6-10	DCN 017
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6-11 thru 6-16	Rev 3
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7-1 and 7-2	Rev 3
7-3	DCN 017
7-4	Rev 3
7-5/7-6	Rev 3
7-7	DCN 017
7-8 thru 7-22	Rev 3
7-23/7-24	Rev 3
7-25	DCN 017
7-26	Rev 3
7-27 and 7-28	DCN 017
7-29/7-30	Rev 3
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7-37/7-38	Rev 3
7-39 and 7-40	DCN 008
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7-45 thru 7-54	DCN 008
7-55/7-56	DCN 008
A-1 and A-2	Rev 3
B-1 and B-2	Rev 3
C-1 and C-2	Rev 3
D-1 thru D-10	Rev 3
F-1 and F-2	DCN 008
F-3/F-4	DCN 008
G-1	DCN 008
G-2 thru G-4	Rev 3
H-1	DCN 008
H-2	Rev 3
H-3	DCN 008
H-4 thru H-8	Rev 3
H-9/H-10	Rev 3

Document History

Original	September 1970
Revision 1	February 1973
Revision 2	May 1974
Revision 3	October 1977
DCN 008	April 1979
DCN 016	February 1980
DCN 017	February 1981

PREFACE

This document provides standard operating instructions for telemetry systems in use in the Spaceflight Tracking and Data Network (STDN). Telemetry receiving systems are discussed in section 2. Intermediate data processing and control equipment is detailed in section 3. Section 4 presents details of associated data handling equipment. Mission-unique equipment is presented in section 5. Typical support activities are contained in section 6, and special support activities are explained in section 7.

Changes to this document may be made by printed or teletype Documentation Change Notices (DCN) or by complete revision.

All comments, suggestions, or questions concerning this document should be directed to:

Bendix STDN Support Office
Goddard Space Flight Center
Greenbelt, Maryland 20771

DCN CONTROL SHEET

Use this control sheet to record the DCN changes to this document.

DCN No.	DTG	Mon/Yr	Sect.	Initials

DATE: February 1981

TO: Distribution

FROM: E. L. Martin, EOG Operations

SUBJECT: STDN No. 502.2, DCN 017

Attached is DCN 017 to Revision 3 of STDN Network Operations Procedures for Telemetry Systems, STDN No. 502.2, dated October 1977. Change bars have been added to indicate new material. Incorporate changed pages and destroy any superseded pages.

Prepared by R. Ore
R. Ore
Telemetry Support Section

Approved by D. McGinley
D. McGinley, Supervisor
Telemetry Support Section

Approved by E. L. Martin
E. L. Martin, Manager
EOG Operations

DATE: February 1980

TO: Distribution

FROM: E.L. Martin, EOG Operations

SUBJECT: STDN No. 502.2, DCN 016

Attached is DCN 016 to Revision 3 of STDN Network Operations Procedures for Telemetry Systems, STDN No. 502.2. Change bars have been added to indicate new material. Incorporate changed pages and destroy any superseded pages.

Prepared by
S.A. Dumas
Telemetry Support Section

Approved by
D. McGinley, Supervisor
Telemetry Support Section

Approved by
E.L. Martin, Manager
EOG Operations

15

79 DEC 4 AM 8 59

#

GTW049A
RR DSDN GTWL GDES
DE GCEN 055B
03/2148Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
F DN NO. 522.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77 DCN NR.015
SUBJECT: CHANGE TO SECTION 7
ACTION: STADIR/OPSR
THIS DCN IS IN RESPONSE TO AGO RIC 1108 UK 6, DTG 21/2221Z NOV. NOTAL.
PAGES 7-31 AND 7-32, PARAS 7.10.2.2A AND 7.10.3.2F. ADD THE FOLLOWING
AT THE END OF BOTH PARAS.
IF THE CLOCK FROM THE MODEM IS INTERRUPTED, THE DECOM SHOULD BE
REINITIATED TO NORMALIZE THE OUTPUT DATA STREAM.
NST TELEMETRY SENDS

03/2151Z DEC 79 GCEN

15

#

GTW262A
RR DSDN GTWL GDES
DE GCEN 061A
20/2315Z
FM NOCC
TO ALL
INFO GTWL/DSO

1979 NOV 21 AM 8 34

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV DATED 3 OCT 77 DCN NR. 014
SUBJECT: CHANGES TO SECTION 7
ACTION STADIR/OPSR/TLM SUP
THIS DCN IS IN RESPONSE TO BDA RIC 1105, DTG 15/1822Z.
PAGE 7-3.
A. PARA 7.2.3.1.
   DELETE THE PARAGRAPH IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:
   7.2.3.1 GENERAL
   METHOD 2 UTILIZES THE DOPPLER DISPLAY OF THE STDN RANGING EQUIPMENT
   (SRE) ON THE COHERENT LINK TO DETERMINE THE PCA. A FREQUENCY
   COUNTER WILL BE CONFIGURED TO MEASURE THE MFR VCO OUTPUT FROM
   THE NON-COHERENT LINK.
B. PARA 7.2.3.2.
   ADD THE FOLLOWING NOTE BELOW SUBPARAGRAPH F.
   NOTE
   IF A COHERENT SIGNAL/LINK IS NOT AVAILABLE TO DETERMINE PCA,
   THE OPERATOR WILL USE THE AVAILABLE INFORMATION (ANGLE UPDATES,
   PREDICTS, AUTO TRACK ANGLES, ETC.) TO DETERMINE THE TIME OF
   PCA.
NST TELEMETRY SENDS

20/2332Z NOV 79 GCEN

15

1979 NOV 14 AM 8 37

#

GTWØ29A
RR DSDN GTWL GDES
DE GCEN Ø37B
13/1924Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 5Ø2.2 NOP TELEMETRY SYSTEM REV 3 DATED OCT 77 DCN NR. Ø13
SUBJECT: CHANGE TO SECTION FOUR
ACTION: STADIR/OPSR

PAGE 4-81/4-82, TABLE 4-24.

CHANGE THE PAGE NUMBER TO READ 4-81 VICE 4-81/4-82.

B. LABEL THE REVERSE SIDE AS PAGE 4-82 AND ADD THE FOLLOWING:

TABLE 4-24. DDPS WORD FORMATTER FRONT PANEL CONTROLS, INDICATORS AND NORMAL SETTINGS (CONT).

CONTROL/INDICATOR	POSITION	PURPOSE
642B/TDC		ROUTES THE FORMATTER OUTPUT TO EITHER THE 642B COMPUTER OR THE TDC.

NST TELEMETRY SENDS

13/1925Z NOV 79 GCEN

15

#

r 26A
RR DSDN GTWL GDES
DE GCEN 035A
02/0239Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77 DCN NR. 012
SUBJECT: CHANGE TO SECTION 5 AND TABLE OF CONTENTS.
ACTION: STADIR/OPSR
1. PAGE 5-43.
    A. PARA 5.2.9.1. CHANGE EXISTING PARA E TO F AND ADD THE FOLLOWING NEW PARA E:
        E. THE MODIFICATION OF THE INPUT SELECTOR/DEMULTIPLEXER CHASSIS, PROVIDES EXTRACTION OF 128 KPS OR 64 KPS TELEMETRY DATA TO THE (CCM) COMPUTER CONTROL MULTIPLEXER LOCATED AT NGT AND TUL.
    B. IN FIRST LINE OF NEW PARA F, AFTER "ME-7173" ADD: AND ADDENDUM TO ME-7173.
    C. PARA 5.2.9.2A. ADD THE FOLLOWING NEW SUBPARA (7):
        (7) DATA DEMUX (TWO PER SYSTEM).
2. PAGE 5-44, FIGURE 5-12.
    A. ON THE LEFT SIDE OF THE DEMOD NO. 2 AND ON THE RIGHT SIDE OF THE DEMOD NO. 1 BLOCKS, ADD THE FOLLOWING DATA DEMUX CHAN 2 AND CHAN 1 BLOCKS RESPECTIVELY:

```
----------                 ----------
!  DATA  !                 !  DATA  !
!        !                 !        !
! DEMUX  !                 ! DEMUX  !
! CH 2   !                 !  CH 1  !
!        !                 !        !
!(NOTE 6)!                 !(NOTE 6)!
!        !                 !        !
!--------!                 !--------!
  !C    !D                   !C    !D
  !L    !A                   !L    !A
  !O    !T                   !O    !T
  !C    !A                   !C    !A
  !K    !                    !K    !
  V     V                    V     V
```

    B. BELOW NOTE 5, ADD THE FOLLOWING NEW NOTE 6:
        6. NGT, TUL ONLY.

MORE

#
GTWØ27A
RR DSDN GTWL GDES
DE GCEN Ø36A
Ø2/Ø239Z

PAGE TWO
3. PAGE 5-47.
A. TABLE 5-9. ADD THE FOLLOWING AT BOTTOM OF TABLE:

PARAMETER	CHARACTERISTIC	
DATA	124 KBP NRZ	64 KBP NRZ
CLOCK	124 KHZ	64 KHZ

B. BELOW TABLE 5-9, ADD THE FOLLOWING NEW TABLE 5-9A:
TABLE 5-9A. DATA RATE VERSUS FORMAT

FORMAT	FORMATTED DATA RATE	TELEMETRY DATA RATE	VOICE DATA RATE
1	192 KBS	128 KBPS	32 KBS V1 V2
2	96 KBS	64 KPS	32 KBS V1
3	72 KBS		32 KBS V1 V2
4	32 KPS		24 KBS V1

4. PAGE 5-48, PARA 5.2.9.4. CHANGE PARAS B AND C TO C AND D; ADD THE FOLLOWING NEW PARA B:
B. THE MODIFIED IS/DX UNIT LOCATED AT NGT AND TUL CAN EXTRACT AND OUTPUT TELEMETRY DATA AND CLOCK IN FORMATS 1 AND 2. THE UNIT WILL NOT PROVIDE TELEMETRY DATA AND CLOCK IF THE FRAME SYNC IS LOST OR IF FORMAT 3 OR 4 IS SELECTED.
5. PAGE XXVII. BELOW TABLE 5-9 ADD:
5-9A DATA RATE VERSUS FORMAT------------------- 5-47
TELEMETRY OPERATIONS SECTION SENDS
END OF MESSAGE

Ø2/Ø242Z NOV 79 GCEN

15

#

1979 OCT 4 PM 3 21

GTW038A
RR DSDN GTWL GDES
DE GCEN 076A
04/1859Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77
DCN NR. 011
SUBJECT: ADDITIONS TO SECTION 7
ACTION: STADIR/OPSR
THIS DCN IS IN RESPONSE TO HAW R0902 SAGE, DTG 18/2116Z NOTAL.
PAGE 7-33/7-34, PARA. 7.11.1
THE FOLLOWING AT THE END OF THE PRESENT PARAGRAPH:
THE BIT NUMBERING IS AS FOLLOW; AS THE WORD APPEARS ON THE DISPLAY, THE LEFT MOST BIT OF THE WORD IS BIT NUMBER ONE(1) AND THE RIGHT MOST BIT OF THE WORD IS BIT NUMBER EIGHT(8) ASSUMING AN 8 BIT WORD. FOR EXAMPLE, XXOXXXXX, THE ZERO IS BIT NUMBER THREE(3).
NST TELEMETRY SENDS

04/1900Z OCT 79 GCEN

15

#

GTWØ63A
RR DSDN GTWL GDFS 1979 SEP 20 AM 8 45
DE GCEN 127A
19/2337Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 5Ø2.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77 DCN NR.
21Ø
SUBJECT: CHANGE TO SECTION 7
ACTION: STADIR/OPSR
THIS DCN RESPONDS TO BDA RIC ØØØ2, DTG 14/14Ø5Z (NOTAL).
PAGE 7-3, PARA 7.2.3.1. DELETE IN ITS ENTIRETY AND REPLACE WITH:
7.2.3.1 GENERAL. METHOD 2 UTILIZES THE DOPPLER DISPLAY OF THE STDN RANGING EQUIPMENT(SRE) ON A NON-COHERENT LINK TO IDENTIFY PCA AND A FREQUENCY COUNTER TO MEASURE TAG MFR VCO OUTPUT FROM THE SECOND NON-COHERENT LINK.
HST TELEMETRY SENDS

19/2342Z SEP 79 GCEN

15

GTW012A
RR DSDN GTWL
DE GCEN 042A
08/0611Z
FM NOCC
TO ALL
INFO GTWL/DSO

1979 SEP 10 AM 8 31

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYS REV 3 DATED OCT 77 DCN NR. 009
SUBJECT: CHANGES TO SECTIONS 6 AND 7.
ACTION: STADIR/OPSR
1. PAGE 6-2, PARA 6.3.1.
ADD NEW SUBPARA K:
K. IF APPLICABLE, PERFORM SYSTEM TIME DELAY MEASUREMENTS AS DESCRIBED IN PARA 7.4.
2. PAGE 6-6, PARA 6.4.1E.
DELETE IN ITS ENTIRETY REPLACE WITH THE FOLLOWING:
E. IF A POSTPASS PLAYBACK OR A S/F BUILD FROM AN ANALOG TAPE IS REQUIRED, PERFORM THE FOLLOWING:
1. RETRIEVE AND MOUNT APPLICABLE ANALOG TAPE.
2. CUE ANALOG TAPE TO AT LEAST 10 SECONDS PRIOR TO TAPE REFERENCED GMT OF REQUESTED DATA START TIME.
3. CONFIGURE APPROPRIATE DDPS DHE AS REQUIRED FOR SUPPORT.
4. CONFIGURE TCT SYSTEM AS REQUIRED FOR SUPPORT (SEE APPLICABLE SECTIONS OF STDN 502.28 FOR INSTRUCTIONS).
5. CHECK ALL REQUIRED SIGNAL FLOW PATHS FOR PROPER FUNCTIONALITY (I.E. ENSURE THAT DATA SYNC/DECOM AND TCT LOCK ON TO THEIR RESPECTIVE INPUTS AND ASSURE VALID INPUTS TO DDPS INPUT PROCESSING SUBSYSTEM).
6. RECUE ANALOG TAPE AS IN 2 ABOVE AND INFORM OPSR WHEN READY FOR PLAYBACK.
3. PAGE 7-7, PARA 7.4.2.1.
DELETE IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING:
7.4.2.1 PRIOR TO AOS (PREPASS CHECKS) AND/OR AFTER LOS PLUS 2 MINUTES, CONFIGURE THE TELEMETRY SYSTEM ACCORDING TO FIGURE 7-2.
NST TELEMETRY SENDS

08/0620Z SEP 79 GCEN

DATE: May 11, 1979

TO: Distribution

FROM: E.L. Martin, EOG Operations

SUBJECT: STDN No. 502.2, DCN 008

Attached is DCN 008 to Revision 3 of STDN Network Operations Procedures for Telemetry Systems, STDN No. 502.2, dated October 1977. Because of the amount of information added to some sections, change bars have been omitted from pages 4-96A through 4-960, 4-160 through 4-181, 5-43 through 5-55, and 7-39 through 7-55. Incorporate changed pages and destroy superseded pages.

Prepared by Jerry L. Jarboe
J. Jarboe
Telemetry Support Section

Approved by R.L. Ore
R.L. Ore, Supervisor
Telemetry Support Section

Approved by E.L. Martin
E.L. Martin, Manager
EOG Operations

GTW036A
RR GTWL DSDN
DE GCEN 029A
05/2333Z
FM NOCC
TO ALL
INFO GTWL/DSO

1979 MAR 6 AM 8 13

18

DCN
STDN NO 502.2 NOP FOR TELEMETRY SYSTEMS REV 3
DATED OCT 77 DCN NR. 007
SUBJECT: CHANGE TO PREFACE
ACTION: STADIR/OPSR

PAGE III/IV. DELETE THE LAST PARA AND REPLACE WITH:
ALL COMMENTS, SUGGESTIONS AND QUESTIONS ON THIS DOCUMENT SHOULD BE DIRECTED TO:
BENDIX STDN SUPPORT OFFICE (SSO)
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

INFO COPY WILL BE SENT TO 852.2.

ECG TESTING SECTION SENDS

05/2334Z MAR 79 GCEN

19

GTW023A
RR DSDN GTWL
DE GCEN 005B
RET

1979 JAN 25 AM 8 2.

RR DSDN GTWL
DE GCEN 075B
24/2258Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77
DCN NR. 026
SUBJECT: CHANGE TO SECTION 6.
ACTION: STADIR/OPSR
PAGE 6-4; PARA 6.3.2.3, DELETE IN ITS ENTIRETY AND REPLACE WITH THE
FOLLOWING:
6.3.2.3 RECORDER LEVELS REFER TO STDN NO. 502.28, NETWORK
OPERATIONS PROCEDURES FOR RECORDER SYSTEMS AND TABLE 6-1 OF THIS
N P FOR MAGNETIC TAPE RECORDER LEVELS AND CALIBRATION PROCEDURES.
JACKSON CODE 852.2 SENDS

24/2323Z JAN 79 GCEN

#

#
GTW035A
RR DSDN GTWL
DE GCEN 068B
12/2220Z
FM NOCC
TO ALL
INFO GTWL/DSO

1978 DEC 13 AM 8 35

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEM REV 3 DATED OCT 77 DCN NR. 005
SUBJECT: CHANGE TO SECTION 6
ACTION: STADIR/OPSR
PAGE 6-8, TABLE 6-2.
A. DELETE TABLE TITLE "PROGRAM TAPE SEQUENCE NUMBERS"
AND REPLACE WITH: TELEMETRY SOFTWARE SEQUENCE NUMBERS.
B. DELETE THE WORDS "DECOMMUTATOR" AND "SIMULATOR" AT TOP OF THE TABLE.
C. DELETE ALL ENTRIES IN THE TABLE AND REPLACE WITH THE FOLLOWING:

MODEL	DESIGNATOR	MODEL	DESIGNATOR
DYNATRONICS MSFTP-2 DECOM	0000D	DYNATRONICS MSFTP-2 SIMULATOR	0000S
MONITOR MSFTP-3 DECOM	0000MD	DYNATRONICS DHS SIMULATOR	0000DS
DYNATRONICS DHS DECOM	0000DD	AYDIN MODEL 1283 DATA GENERATOR	0000DG
MONITOR 403/SETUP CONTROLLER	0000FR	DATA SYNC SETUP CONTROLLER (DSSC)	2000-2999SC
MONITOR 401/SETUP CONTROLLER	0000FR		
DUPLEX DIGITAL DATA FORMATTER (DDDF)	0000DF		

W JACKSON CODE 852.2 SENDS

12/2222Z DEC 78 GCEN

#

1978 OCT 19 22 50

CEN084A
RR DSDN GTWL
DE GCEN 084A
19/2245Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77 DCN NR.
004
SUBJECT: CORRECTION TO DCN 003
ACTION: STADIR/OPSR
THIS DCN CORRECTS DCN 003, DTG 17/2315Z, WHICH IN PART COULD NOT
BE POSTED. IT ALSO RESPONDS TO ORR SR 10-01, DTG 19/0105Z (NOTAL).
ITEM 7 POSTING INSTRUCTIONS WERE INCORRECT. THEY SHOULD HAVE READ
PAGE H-3, TABLE H-2 VICE PAGE H-3, TABLE H-3.
DOCUMENTATION SENDS

19/2246Z OCT 78 GCEN

058. DCN TO 500 SERIES
(EXCEPT 502.16 AND 508)

815.1 851.2 851.3 852.1 852.2-2
852.3 MED-2 OTS MSO-2 SC DOC-3
NLC-2 SKS MOS OPS TC RES

Jackson (852.2)

#

1978 OCT 17 23 31

CEN179A
RR DSDN GTWL
DE GCFN 179A
17/2315Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77
DCN NR. 003
SUBJECT: CHANGE TO APPENDIX F, G, H
ACTION: STADIR/OPSR
1. PAGE F-1, TABLE F-1.
   A. IN THE FIGURE TITLE DELETE "(DDPS NORMAL MODE)" AND REPLACE WITH "(DDPS TRANSFER)".
   B. DELETE THE LINE FOR COMPUTER BUFFER BIT 2 EXPONENT 20, WHICH READS:
      OPEN 0 2 EXPONENT 20
      AND REPLACE WITH:
      AX DN TAPE PLAYBACK NO. 1 2 EXPONENT 20

2. PAGE F-2, TABLE F-2. DELETE WITH PAGE ENTIRELY.

3. PAGE F-3, TABLE F-3. RENUMBER AS PAGE F-2 AND TABLE F-2.

4. PAGE F-4, TABLE F-4. RENUMBER AS PAGE F-3 AND TABLE F-3.

5. PAGE G-1, TABLE G-1. DELETE THE LINE FOR COMPUTER BUFFER BIT 2 EXPONENT 20 WHICH READS:
   20 20 NOT DEFINED 2 EXPONENT 20
   AND REPLACE WITH:
   20 20 TP 1 TAPE PLAYBACK 2 EXPONENT 20

6. PAGE H-1, TABLE H-1. DELETE THE LINE FOR COMPUTER BUFFER BIT 2 EXPONENT 20 AND REPLACE WITH:
   F15 B4 TAPE PLAYBACK NO. 1 2 EXPONENT 20

7 PAGE H-3, TABLE H-3. DELETE THE LINE FOR COMPUTER BUFFER BIT 2 EXPONENT 20 AND REPLACE WITH:
   F15 B4 TAPE PLAYBACK NO. 2 2 EXPONENT 20
W. JACKSON CODE 852.2 SENDS

17/2325Z OCT 78 GCEN

058, DCN TO 500 SERIES
(EXCEPT 502.16 AND 506)
JACKSON (852.2)
815.1 851.2 851.3 852.1 852.2-2
852.3 MED-2 OTS MSC-2 SC DCC-3
NLC-2 SKS MUS OPS TC RES
JARDOE(TSS)

25/ 8d

1978 APR 10 AM 8 42

GTWØØ9A
RR DSDN GTWL
DE GCEN Ø21B
Ø8/Ø216Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 5Ø2.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED ØCT 77 DCN
NR. ØØ2
SUBJECT: CHANGE TO SECTION 6
ACTION: STADIR/OPSR
THIS DCN BECOMES EFFECTIVE UPON RECEIPT OF SCAN 6-358 AND ASSOCIATED
TAPE.

PAGE 6-1Ø, PARA 6.6.2.8B. IN LINE THREE DELETE THE EXISTING SCAN
CONTROL NO. AND REPLACE WITH SCAN CONTROL NO. 6-358.
W. JACKSON CODE 852.2 SENDS

Ø8/Ø217Z APR 78 GCEN

#

1978 APR 5 AM 8 44

GTW004A
RR DSDN GTWL
DE GCEN 017A
05/0155Z
FM NOCC
TO ALL
INFO GTWL/DSO

DCN
STDN NO. 502.2 NOP FOR TELEMETRY SYSTEMS REV 3 DATED OCT 77
DCN NR. 001
SUBJECT: CHANGE TO SECTION 6
ACTION: STADIR/OPSR
NOTE: NOT FOR POSTING - THIS DCN TO BE POSTED UPON RECEIPT OF SCAN 6-354 AND ASSOCIATED TAPE.
PAGE 6-12, PARA 6.6.2.8B.
IN LINE THREE DELETE "SCAN CONTROL NO. 6-323 AND REPLACE WITH "SCAN CONTROL NO. 6-354".
W. JACKSON CODE 852.2 SENDS

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SECTION 1. INTRODUCTION

SECTION 1. INTRODUCTION

1.1 PURPOSE

The purpose of this Network Operations Procedure (NOP) is to describe the operation and operating procedures of telemetry equipment in use at stations of the Spaceflight Tracking and Data Network (STDN).

1.2 SYSTEM ALLOCATION

The configuration of telemetry equipment varies at different stations and with different types of antennas. Figure 1-1 is a block diagram of the basic telemetry interface. Figure 1-2 shows a block diagram of typical telemetry systems. Refer to the STDN Mnemonic Dictionary, STDN No. 520 for the complete STDN equipment listing.

1.3 DOCUMENTATION

1.3.1 MAINTENANCE AND TESTING

Documents describing the maintenance and testing of STDN equipment are called Equipment Maintenance Directives (EMD). The EMD's applicable to telemetry equipment are listed in the Index of STDN Operations Documentation, STDN No. 102.3.

1.3.2 OPERATION

Documents describing the equipment setup parameters and equipment configurations required for various spacecraft are called out in the Network Operation Support Plans (NOSP), STDN No. 601/Mission.

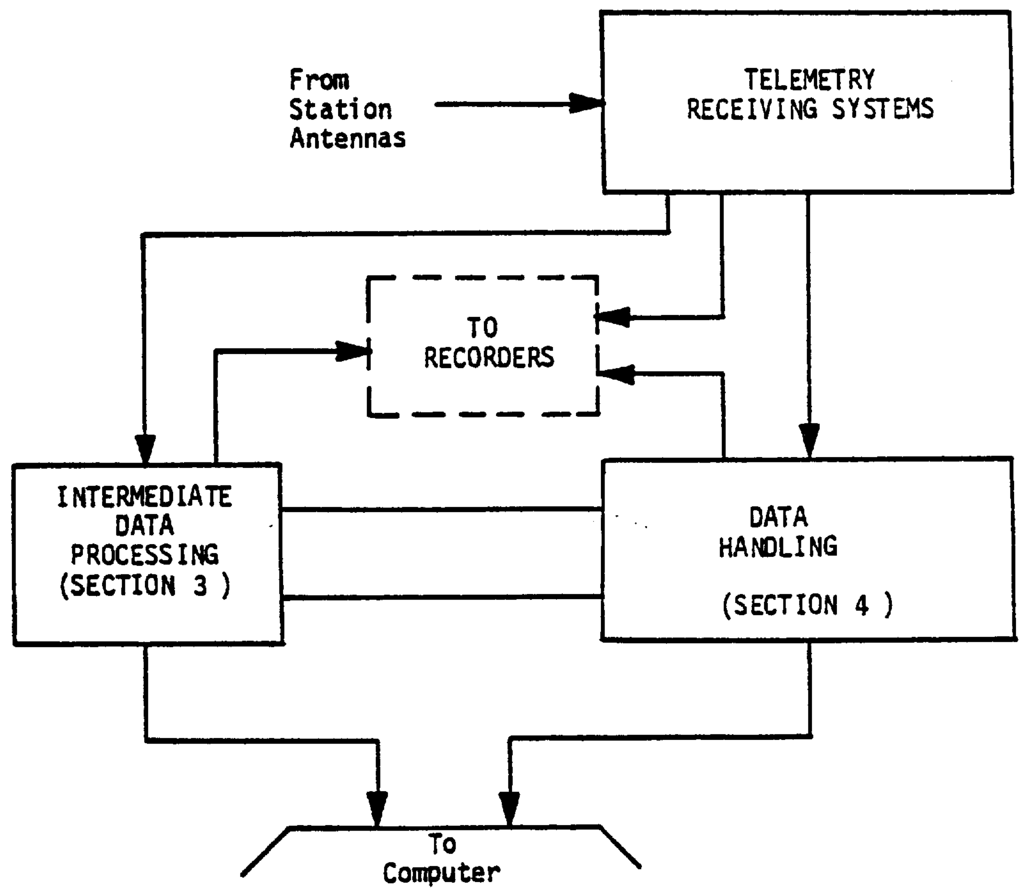
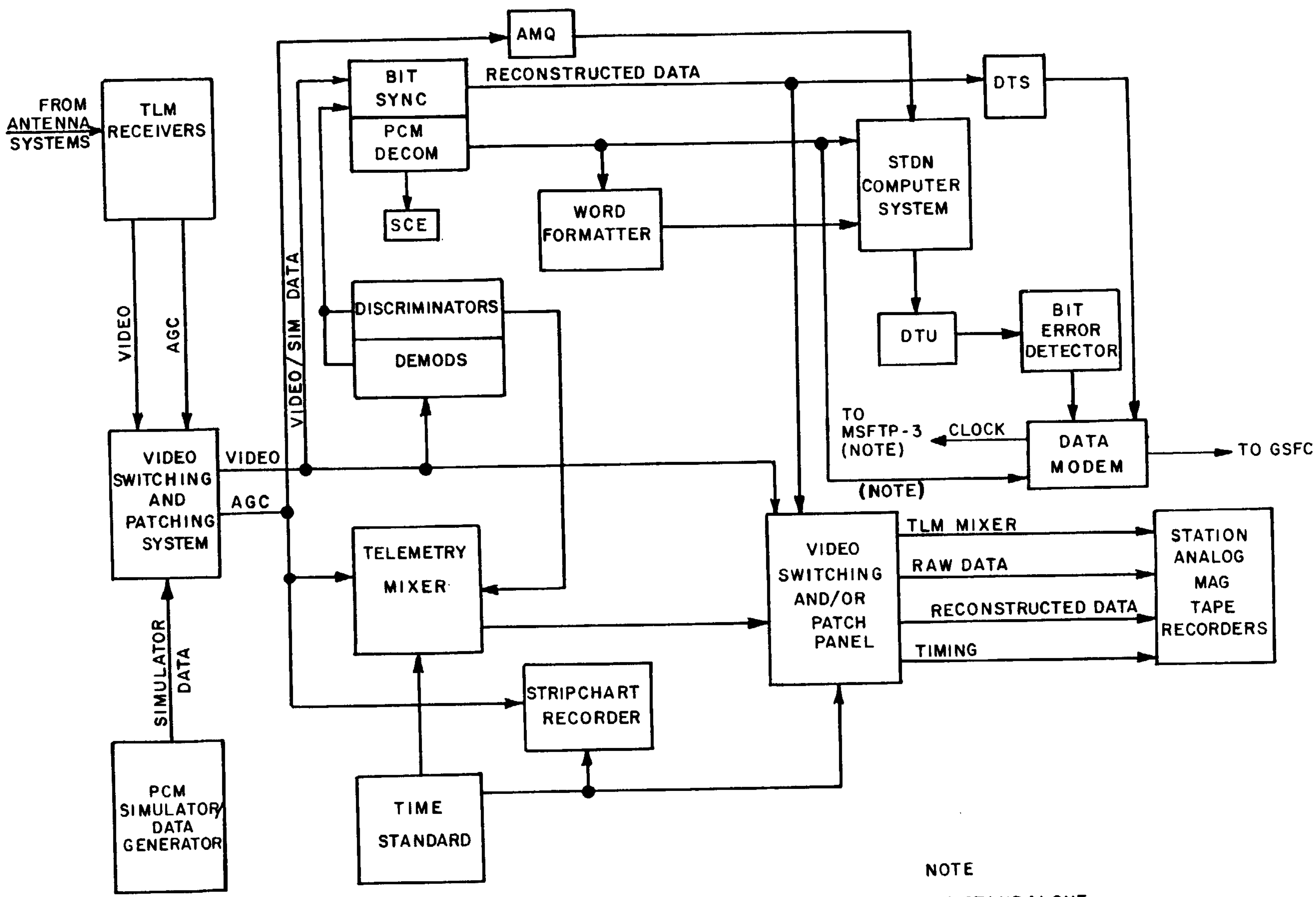


Figure 1-1. Basic Telemetry Interface and Location Block Diagram



NOTE

MSFTP-3 STANDALONE OPERATION REQUIRES MODEM CLOCK FROM MODEM BEING USED.

Figure 1-2. Typical Telemetry System

SECTION 2. TELEMETRY RECEIVING SYSTEMS

Section 2, including the following information, has been deleted:

SECTION 2. TELEMETRY RECEIVING SYSTEMS

Figures 2-1 and 2-2

Tables 2-1 through 2-4

Pages 2-1 through 2-12

Table 2-1. Microdyne 2200-R (N) Receiver Characteristics

Parameter	Characteristics
Frequency Range	105 to 320 MHz, depending on RF tuner installed.
Input Impedance	50 Ω.
Input VSWR	1.5:1 max.
Noise Figure	5.0 to 10 dB max depending on RF tuner installed.
Image Rejection	80 dB min.
Dynamic Range	Threshold to -7 dBm; threshold defined as +6 signal-to-noise ratio.
<u>AFC Characteristics</u>	
Tracking/Acquisition Range	±250 kHz in addition to second LO. ±250 kHz fine tuning range.
Doppler	Will track Doppler changes up to 15 kHz/sec.
<u>IF Filter</u>	
IF Bandwidths	Filters are available in bandwidths between 10 kHz and 6 MHz.
Input/Output Impedance	50 Ω.
<u>AGC Output</u>	
Output	0 to ±10 Vdc.
Control Range	0 to -130 dBm depending on demodulator type, IF BW, and tuner noise figure.
<u>Video</u>	
Output Level	Up to 10 Vpp into 50 ohm with less than 20-percent distortion, 4 Vpp rated output with less than 0.5-percent distortion.

Table 2-1. Microdyne 2200-R (N) Receiver Characteristics (cont)

Parameter	Characteristics
Pre-D Playback	
Input Frequencies	112.5, 225, 450, 900 kHz record carriers.
Input Level	0.5 to 5.0 Vpp.
Data Bandwidth	150 kHz at 112.5 kHz carrier. 300 kHz at 225 kHz carrier. 600 kHz at 450 kHz carrier. 1200 kHz at 900 kHz carrier.
Power	
Voltage	115/230 Vac.
Frequency	50 to 400 Hz.

Table 2-2. Microdyne 2200-R (N) Receiver Front- and Rear-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON	Turns on unit.
AUDIO SELECTOR switch	CHAN 1 OFF CHAN 2	Selects which channel will drive speaker.
AUDIO GAIN control	Variable	Controls speaker gain.
▼ VIDEO COUPLING switch	AC DC	Selects ac or dc video coupling.
VIDEO GAIN (2 controls)	CHAN 1 CHAN 2 Variable	Video output control for chan 1 and chan 2.
▼ VIDEO BANDWIDTH KHZ switch	6.25 12.5 25 60 100 250 500 750 1000 1500 OUT	Sets video output frequency response.
▼ IF BANDWIDTH KHZ switch	1 2 3 4 5 6	Sets IF bandwidth as follows: 1=30 2=100 3=300 4=500 5=1000 6=5000 (1500)
▼ PRE-D PLAYBACK switch	112.5 225 450 900	Selects up - converted carrier. (Specified in NOSP if required.)
SEPARATE/COMMON toggle switch	SEPARATE COMMON	Selects separate or common second LO.
MAN GAIN control	Variable	Adjusts gain of the receiver when not in AGC mode.
CONTROL switch	LOCAL REMOTE	Provides local or remote control.

▼Specified in NOSP.

Table 2-2. Microdyne 2200-R (N) Receiver Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
2ND LO MODE switch	OFF EXT XTAL PM VFO AFC	Selects mode of second LO. When AM or FM demod is used, the VFO position will be used. When a PM demod is used, PM position will be used.
CH2, Demod (Rear panel)	INT/J36	Selects 10-MHz internal IF, or external 10-MHz combined signal.
AGC TIME CONSTANT MSEC switch	MAN 0.1 1.0 10 100 1 K	Selects AGC response time.
▼OPERATE MODE switch	50 MHZ PBK REC BAL ZERO	Selects receiver mode of operation.
FM Demodulator		
SEARCH RANGE control	Variable	Sets AFC capture range.
FINE TUNE control	+/- Variable	Fine tunes VCO.
▼DEVIATION KHZ switch	1.5, 5.0, 15 — NAR 15, 50, 150 — MED 150, 500, 1500 — WIDE	Selects FM demod bandwidth.
AFC TIME CONSTANT switch	.01 0.1 1.0	Selects AFC time constant.
RFT		
▼TUNING MHZ control	215-320 Variable	Selects input frequency when in VFO mode.

▼ Specified in NOSP. Receiver frequency will be specified in NOSP.

Table 2-2. Microdyne 2200-R (N) Receiver Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
RFT (cont)		
CRYSTAL SELECT switch	1 2 3 4 5 6 7 8 9 OVEN	Selects crystal position when in Xtal mode.
1ST LO MODE switch	VFO (RTM) VFO EXT LO XTAL	Selects first LO mode.
PM Demodulator		
▼ $2B_{LT}$ HZ switch	10 30 100 300 1000	Used to select the phase tracking loop bandwidth in Hz.
AM/AGC switch	SYNC ENV	Used to select the AM video and AGC outputs of the demodulator. In the SYNC (synchronous) position, the AM video is obtained from the output of the demodulator synchronous AM detector. The AGC output will be synchronous when the demodulator is phase locked and envelope AGC will be supplied when it is not locked. In the ENV (envelope) position the AM video output is the envelope AM supplied by the receiver AM detector module. The AGC output is the envelope AGC supplied by the AM detector module.
LOOP momentary spring-loaded switch	OPEN CLOSED	When pressed, opens the phase tracking loop to permit manual acquisition.
SEARCH switch	MANUAL AUTO	Selects either the manual or automatic search for lock operating mode.

▼ Specified in NOSP.

Table 2-2. Microdyne 2200-R (N) Receiver Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
IF BW-KHZ switch	10 100 MIN 30/50	Adjusts the feedback in the AM circuitry to compensate for the varying noise levels at different IF bandwidths. Compensation is provided for 10-kHz, 30/50-kHz, and 100-kHz minimum second IF bandwidths.
BAL N/C control LOCK BAL switch		The noise balance (N BAL) control is used to minimize the dc offset in the loop phase detector. The lock balance (L BAL) control and LOCK BAL switch are used to minimize the dc offset in the coherent amplitude detector.
TUNE control	-250 kHz 0 +250 kHz	Connected to the receiver second LO and its positioning determines the oscillator center frequency. Using this control, the center frequency can be changed ±250 kHz from the nominal 60-MHz output.
LOOP LOCK indicator		A Light-emitting Diode (LED) which lights when the demodulator is phase locked.

2.3 MICRODYNE 3300-C (N) DIVERSITY COMBINER

The 3300-C (N) diversity combiner is used in conjunction with the 2200-R (N) receivers. It combines either two IF predetection signals or two video postdetection signals. It provides an output that is a down conversion of the two IF input signals to standard predetection recording frequencies. It also has a complete upconversion and demodulation capability for use in either real-time monitoring of the recording process or playback of recorded data. It also has the additional capability to use out-of-band noise for combining control in addition to AGC. Figure 2-2 is a block diagram of the 3300-C (N). Characteristics are described in table 2-3, and controls are listed in table 2-4.

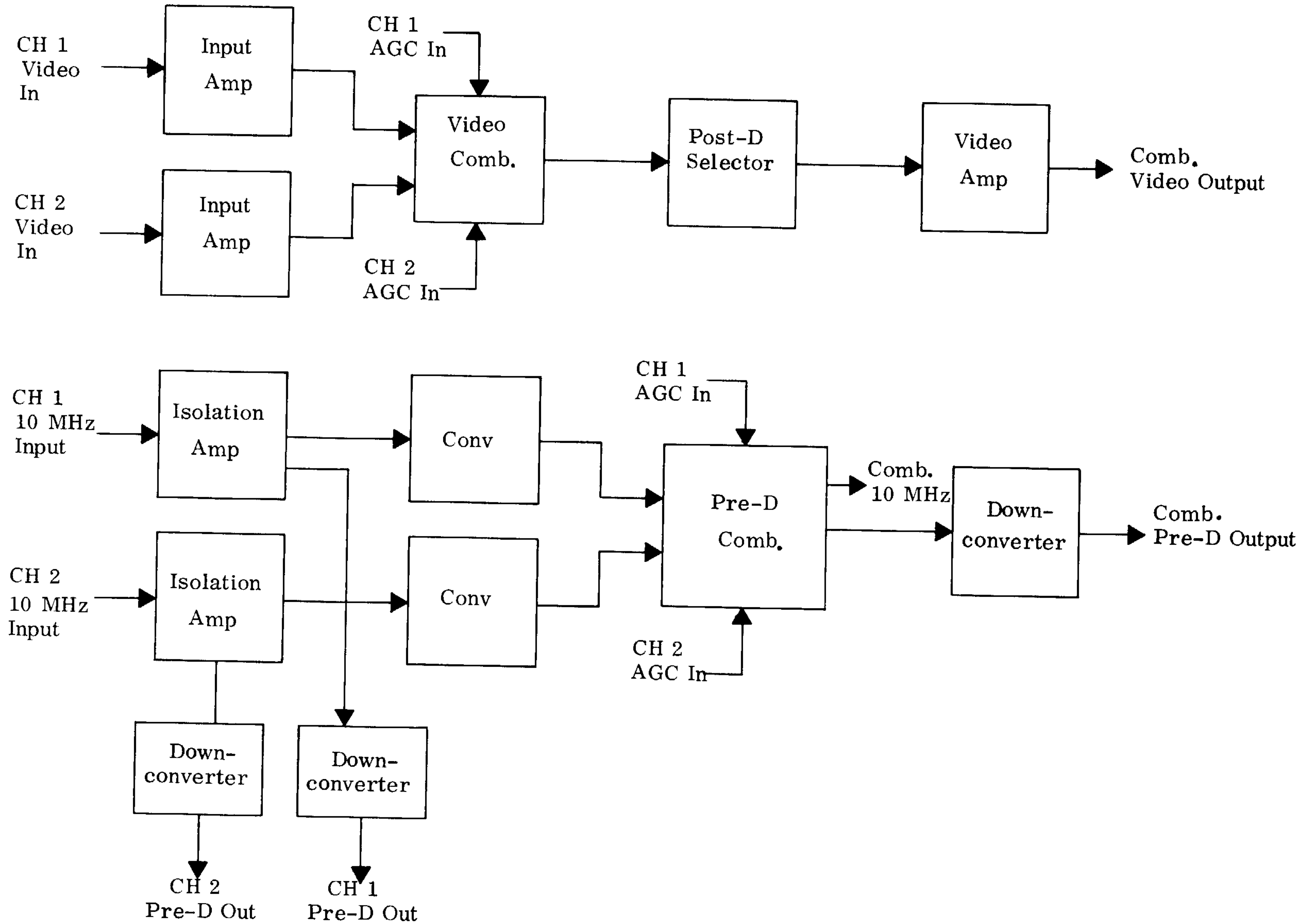


Figure 2-2. Microdyne 3300-C (N) Diversity Combiner Block Diagram

Table 2-3. Microdyne 3300-C (N) Diversity Combiner Characteristics

Parameter	Characteristics
<u>Signal-to-noise Improvement</u>	
Equal S:N Ratios	2.3 dB.
<u>Demodulated Improvement</u>	
Pre-D Mode	Greater than 3 dB in threshold region.
<u>Downconverter</u>	
Input Frequency	10 MHz, 100 mVrms.
Output Level	2 Vpp into 75 Ω .
Record Carrier	112.5 kHz with 37.5 to 187.5 kHz data BW.
Center Frequencies	225 kHz with 75 to 375 kHz data BW. 450 kHz with 150 to 750 kHz data Bw. 900 kHz with 300 kHz to 1.5 MHz data BW.
<u>Combined Video Output</u>	
Level	0-10 Vpp.
Impedance	50 Ω .
<u>AGC Input</u>	
Impedance	400 k Ω min.
Voltage Range	0 to 10 Vdc.
Common Mode Rejection	Less than ±0.5 dB variation in combined video output with simultaneous variations of both AGC inputs over their range.

Table 2-4. Microdyne 3300-C (N) Diversity Combiner Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON	Turns on unit.
▼ MODE switch	PRE-D POST-D	Selects combiner mode of operation.
MODE switch	AGC NOISE	Selects combiner mode of operation.
CONTROL meter	CHAN 1 COMB CHAN 2	Control meter.
VIDEO switch	CHAN 1 COMB CHAN 2	Selects input to video meter.
CHAN 1 control	Variable	Video out channel 1.
CHAN 2 control	Variable	Video out channel 2.
COMB control	Variable	Video out comb. video.
TUNE control	Variable	Tunes freq of phase-locked loop OSC.
▼ RECORD switch	112.5 225 450 900	Selects PRE-D recording carrier center frequency output. (Specified in NOSP when applicable.)
AGC switch	NEG POS	Selects AGC output polarity.
AUDIO control	Variable	Adjusts speaker level.
CONTROL switch	LOCAL REMOTE	Allows local or remote operation.

▼ Specified in NOSP.

SECTION 3. INTERMEDIATE DATA PROCESSING AND CONTROL EQUIPMENT

SECTION 3. INTERMEDIATE DATA PROCESSING AND CONTROL EQUIPMENT

Note

Underscored entries appearing in the Position column in tabular information for controls and indicators in this document indicate nominal settings.

3.1 SUBCARRIER DISCRIMINATORS

3.1.1 GENERAL

The FM demodulation equipment used on STDN stations consists of IRIG and non-IRIG discriminators. These discriminators are used to demodulate FM subcarrier multiplexed signals downlinked from a spacecraft. The demodulators used are bandswitching, fixed channel, and tunable types. Some of these discriminators contain tape speed compensation circuitry to correct for erroneous subcarrier modulations caused by tape speed errors. In normal STDN configurations this input is not used and is shorted to ground. The standard IRIG subcarrier channels are listed in appendix A.

3.1.2 METRAPLEX 120 FIXED DISCRIMINATOR

3.1.2.1 The discriminator is a compact, highly stable, double pulse averaging FM demodulator. It can be used either as a data demodulator or as a tape speed compensation reference signal demodulator.

3.1.2.2 When used as a data demodulator, it provides an analog output for application to stripchart recorders, quick-look displays, or data processing instruments.

3.1.2.3 The discriminator demodulates FM subcarrier signals within the frequency range of 300 Hz to 2 MHz, with deviations from ±1 percent to ±40 percent, either single channel or multiplexed, and produces output data within the frequency range from dc to 400 kHz. FM subcarrier signals are selected from a multiplex by the Model 120 Demodulator Channel Selector, a factory adjusted plug-in unit. The modulating signal is detected using a double pulse averaging technique, and the resulting output data signal is filtered by the Model 120 Demodulator Output Filter, another factory adjusted plug-in unit which establishes the output response characteristics of the discriminator. Cutoff frequencies from 2 Hz to 400 kHz are available. Linear phase or constant amplitude filter characteristics are available, either individually, or combined with front-panel switch selection.

3.1.2.4 Table 3-1 lists the characteristics and table 3-2 contains the controls, indicators, and nominal settings of the discriminator.

Table 3-1. Metraplex 120 Fixed Discriminator Characteristics

Parameter	Characteristics
Model 120 FM Demodulator	
Subcarrier Frequency	300 Hz to 2 MHz (determined by Model 120 Demodulator Channel Selector).
Subcarrier Deviation	±1 to ±40% (determined by Model 120 Demodulator Channel Selector).
Input Signal Level	2 mVrms to 2 Vrms for all subcarrier frequencies and deviations.
Input Impedance	Greater than 200 kΩ shunted by less than 30 pF.
Nonlinearity	Less than 0.05% of span from best straight line.
Output Voltage Level	Two overlapping ranges: ±1 to ±3.5 V, and ±3.5 to ±10 V.
Output Level Adjustability	Able to be set within 0.1% of desired output level.
Output Current	100 mA maximum for all output frequencies.
Output Impedance	Less than 0.5Ω from dc to 400 kHz.
Output Frequency Response	Sufficient to maintain specified output filter response characteristics for cutoff frequencies up to 400 kHz.
Output Limiting	For all settings of output level control, output voltage is limited to 130% of full deviation output, and output current is limited to 140 mA maximum.
Output Noise	Less than 10 mVrms for deviation ratios of 2 or greater.

Table 3-1. Metraplex 120 Fixed Discriminator Characteristics (cont)

Parameter	Characteristics
Model 120 FM Demodulator (cont)	
Output Protection	Output can be shorted to ground without damage.
Capacitive Loading	Capacitive loads up to 0.01 μF can be driven as long as output current required does not exceed 100 mA.
Harmonic Distortion	Less than 0.5 % for a deviation ratio of 2, and less than 0.25 % for a deviation ratio of 5 (when employed in a system with Metraplex Model 110, 111, and 114 VCO).
Output Zero Adjustability	Able to be set within 0.003 % of center frequency.
Output Zero Stability	Temperature coefficient per degree Celsius less than amount equal to 0.005 % of center frequency.
Deviation Sensitivity	Temperature coefficient per degree Celsius less than 0.01 %.
Loss of Signal	When input signal level drops below threshold (adjustable from 1 to 40 mVrms) front-panel LO IN indicator lights and output is clamped to 0 V.
External Squelch	Output may be clamped to 0 V by external +4 V squelch signal. Each demodulator also provides squelch output signal that may be used to squelch other demodulators.
Tape Speed Compensation	Noise produced by up to 6 % peak-to-peak flutter is attenuated at least 30 dB for deviation ratio of 5, and at least 20 dB for deviation ratio of 2, provided that subcarrier remains within pass band of demodulator.

Table 3-1. Metraplex 120 Fixed Discriminator Characteristics (cont)

Parameter	Characteristics
Model 120 FM Demodulator (cont)	
Overdeviation Detection	When input subcarrier is deviated more than 105 % of normal deviation, front-panel LIMIT indicator is lighted, and overdeviation flag is generated.
Autoset Test Modes	In zero set mode, demodulator is automatically adjusted to 0 V output to within 0.1 % of output setting; if required zero correction exceeds range of autoset, panel LIMIT indicator is lighted. In span check mode, output level is checked to tolerance limit of 0.2 % of desired output; if error exceeds this value, front-panel LIMIT indicator is lighted.
Power Required	Less than 7 W (provided by module housing).
Temperature Range	0 to +50° C, operating; -20 to +75° in storage.
Size	Occupies two module widths (1.58 inches) in 5¼ inch high module housing.
Model 120 Demodulator Channel Selector	
Adjacent Channel Attenuation	At least 24 dB for adjacent channel signals located beyond three times normal deviation.

Table 3-1. Metraplex 120 Fixed Discriminator Characteristics (cont)

Parameter	Characteristics
Model 120 Demodulator Channel Selector (cont)	
Data Response	Attenuation of approximately 0.75 dB is imposed on output data at frequency corresponding to a modulation index of 2.
Channel Frequencies	Channel selectors are available for all IRIG proportional bandwidth and constant bandwidth channels, for all standard constant bandwidth channels, for all channel-per-track tape recording frequencies, and other frequencies and deviations within specified operating range.
Model 120 Demodulator Output Filter	
Response Characteristics	Linear phase or constant amplitude characteristics are available either individually or combined with front-panel switch selection.
Linear Phase Characteristic	Provides maximally flat envelope delay characteristics; 3 dB attenuation at specified cutoff frequencies, with slope asymptotic to 6 dB per octave per pole.
Constant Amplitude Characteristic	Provides maximally flat frequency response characteristics; 0.5 dB attenuation at specified cutoff frequency, with slope asymptotic to 6 dB per octave per pole.

Table 3-1. Metraplex 120 Fixed Discriminator Characteristics (cont)

Parameter	Characteristics
Model 120 Demodulator Output Filter (cont)	
Cutoff Frequencies	Cutoff frequencies from 2 Hz to 400 kHz are available.
	Available output filters include, but are not limited to, the following versions: a. Model 120-2X, five pole switchable CA/LP. b. Model 120-3X, five pole CA. c. Model 120-4X, five pole LP. d. Model 120-51, reference for tape speed confirmation. e. Model 120-5X, three pole, CA. f. Model 120-6X, three pole, LP. g. Model 120-7X, five pole, switchable, two frequency. h. Model 120-9X, three pole, switchable CA/LP, polarity reversal, switchable offset (squelch and autoset are disabled, 10 Vpp output).

Table 3-2. Metraplex 120 Fixed Discriminator Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Output Deviation meter		When handling data, indicates percent of deviation.
CA/LP switch	CA/LP	Selects Constant Amplitude (CA) or Linear Phase (LP) characteristics of output filter.
GAIN control	As required	Adjusts output amplitude.
HI/LO switch	As required	Enables selection of maximum output voltage. In HI position, voltage can be adjusted over ±3.5 to ±10 V. In LO position, voltage can be adjusted from ±1 to ±3.5 V (using GAIN control).
LIMIT indicator		Indicates subcarrier deviation in excess of 105%.
LO IN indicator		Indicates input signal below preset threshold limit.

3.1.3 EMR 210 FIXED DISCRIMINATOR

3.1.3.1 This discriminator consists of a 210A-01-M20 Phase-lock-loop FM Detector, a 210B-01 Channel Selector, and a 210C-01 Output Filter. A plug-in channel selector is used in each discriminator to select the individual multiplexed subcarrier desired. A plug-in output filter determines the data output signal response. Filters are available from 1 Hz to 45 kHz. The discriminators are mounted in racks; a 19-inch rack houses a Model 223B Power Supply and six Model 210 Discriminators complete with channel selectors and output filters.

3.1.3.2 The Model 223B Power Supply provides all required operating voltages for up to six discriminators. Included in the power supply chassis is a subcarrier amplitude meter for monitoring the composite ac input level.

3.1.3.3 The EMR 210 Fixed Discriminators have the following operating characteristics:

a. Dynamic input signal range: 0.010 to 10 Vrms.

b. Single-ended output voltage referenced to ground. The BANDEDGE VOLTS control on the channel selector can be adjusted to vary the dc bandedge output voltage continuously from 1.0 to 10 V.

3.1.3.4 Figure 3-1 is a block diagram of the EMR 210 fixed discriminator, table 3-3 contains characteristics, and table 3-4 lists the front-panel control functions.

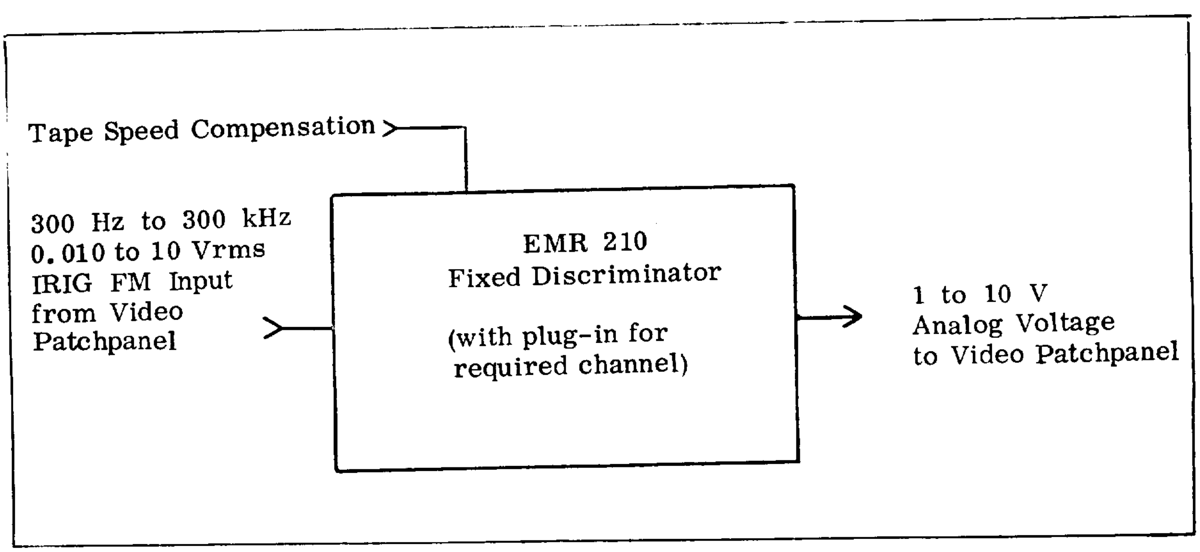


Figure 3-1. EMR 210 Fixed Discriminator Input-output Diagram

Table 3-3. EMR 210 Fixed Discriminator Characteristics

Parameter	Characteristics
Input Impedance	100 kΩ shunted by less than 50 pF capacitance.
Dynamic Input Signal Range	10 mV to 10 V peak.
Crosstalk of Adjacent Channel	Attenuated 60 dB.
Output Noise	Value (rms) of less than 0.05% of the full bandwidth voltage.
Output Voltage	1.0 to 10 V.
Output Current	100 mA max.
Output Impedance	1.0Ω or less at 10 V bandedge, decreasing linearly to 0.1Ω or less at 1.0 V bandedge.
Harmonic Distortion	For deviation ratio of 5 or greater does not exceed 0.05 % for any modulation frequency up to the cutoff frequency of the channel.

Table 3-4. EMR 210 Fixed Discriminator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
Power Supply		
OFF/ON switch	OFF ON	Turns on unit.
METER RANGE switch	0 .1 .3 1 3 10	Meter range selector.
DISCRIMINATOR switch	1 2 3 4 5 6	Monitors carrier level at the output of the bandpass filter at the selected discriminator.
Discriminator		
BANDEDGE VOLTS control	Variable	Adjusts dc output voltage.
CHANNEL FILTER LOOP WIDTH * control	1 5 10 25 50 100	Adjusts time constant of phase-lock loop.
▼ DEVIATION % * switch	7.5 15	Selects input channel filter bandwidth.
BALANCE control	Variable	Adjusts freq at low bandedge.
Output Filter		
▼ DELAY/AMPLITUDE switch	DELAY AMPLITUDE	Selects either constant amplitude or constant delay filter characteristics.

* Not on all models.

▼Specified in NOSP.

3.1.4 SONEX 34-01 AND -02 BANDSWITCHING DISCRIMINATORS

These discriminators are designed for IRIG subcarrier channels 1 through 18 and A through E. Separate rotary switches are provided for independent selection of the subcarrier channel and the output filters. Input and output connections are shown in figure 3-2. The characteristics of the discriminators are given in table 3-5 and the controls are described in table 3-6.

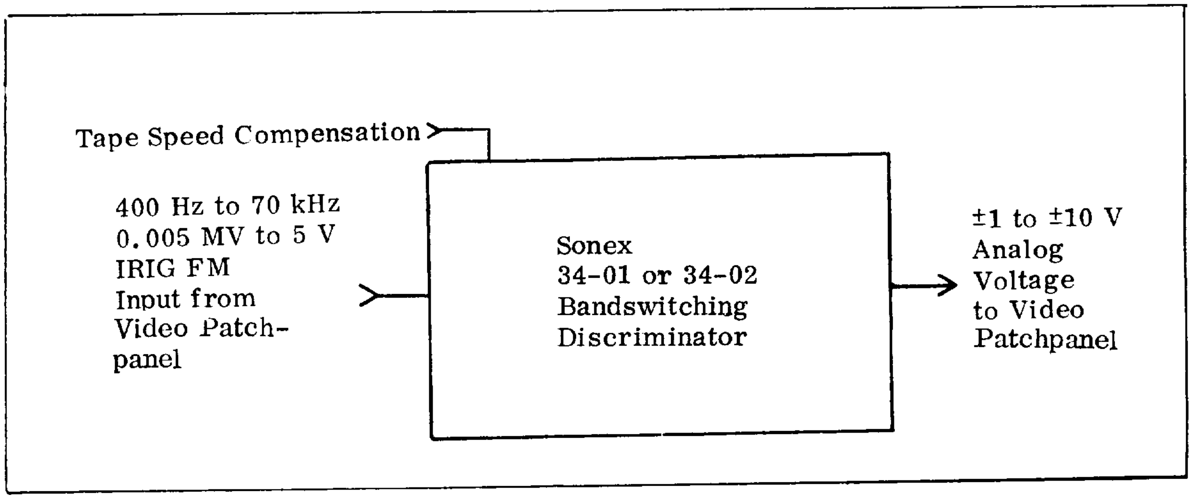


Figure 3-2. Sonex 34-01 and -02 Bandswitching Discriminators Input-output Connections

Table 3-5. Sonex 34-01 and 34-02 Bandswitching Discriminators Characteristics

Parameter	Characteristics
Channel Coverage	Any IRIG channel, 1 through 18 or A through E.
Signal Range	5 mVrms to 5 Vrms.
Linearity	Within ±0.1 % of bandwidth.
Output Voltage	Adjustable from ±1 to ±10 V for bandedge deviation.
Output Filter Response	Flat within ±0.5 dB of IRIG standard modulating frequencies.
Autocal	Rear connections are available for remote zero and gain control.
Tape Speed Compensation	30-dB improvement for tape-speed errors as large as ±3 percent with external or internal reference discriminator.

Table 3-6. Sonex 34-01 and 34-02 Bandswitching Discriminators Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
SUBCARRIER AMPLITUDE meter		Used in conjunction with the METER RANGE switch to measure the amplitude of the input signal appearing at the input of the discriminator.
▼CHANNEL SELECTOR switch	1-18 A-E	Selects the desired IRIG subcarrier channel.
Zero Adjust		Used to zero each subcarrier channel.
▼OUTPUT FILTER switch	1-18 A-E	Selects one of 23 IRIG low-pass cutoff frequencies.
PERCENT BANDEDGE meter		Indicates deviation of subcarrier in percentage of bandwidth.
LOSS LOCK indicator		Lights when phase-locked loop is in loss-of-lock condition.
LOW SIGNAL indicator		Lights to indicate an input signal amplitude less than normal operating level.
METER RANGE switch	.03 0.1 0.3 1.0 3.0 10	Selects meter range for the subcarrier amplitude meter.
INPUT test jack		Used to monitor bandpass filter output.
GROUND test jack		Used to make an electrical ground connection.
OUTPUT test jack		Used to monitor discriminator output.
OUTPUT VOLTS control		Used to adjust output voltage for bandedge deviation. With channel bandedge freq input, set for output which corresponds to the edge freq input. (e.g. F_u = Vmin, F_l = Vmin).
Power indicator		Lights to indicate power is on.
POWER switch	ON OFF	Energizes the equipment.
TSC ZERO adjust*		Used to zero internal reference discriminator output.
TSC OUTPUT test jack*		Used to monitor internal reference discriminator output.
TSC ON/OFF switch*	ON OFF	Used to disable internal reference discriminator output.

*TSC controls are not used when model 34-02 is used with external reference discriminator. These controls are not present on the model 34-01.

▼Specified in NOSP.

3.1.5 SONEX S-45 FIXED DISCRIMINATOR

The Sonex S-45 fixed discriminators are housed in 19-inch rack mounts. One rack mount contains a Sonex S-59 Subcarrier Monitor, a Sonex S-27 Power Supply, and 10 Sonex S-45 Discriminators. The operating characteristics of the individual units are as follows:

3.1.5.1 The S-59 Subcarrier Monitor contains a meter and a six-position meter-range switch for monitoring the input composite ac subcarrier level.

3.1.5.2 The S-27 Power Supply provides all the necessary operating voltages for up to 10 S-45 discriminators.

3.1.5.3 The S-45 Discriminator is designed to provide a fixed output of +5 Vdc with a center frequency input. The carrier input range is from 0.005 to 5 Vrms. The discriminator contains an auxiliary 100-kHz tape speed compensation input circuit which may be used when reproducing recorded data providing a data output improvement for tape-speed variations.

3.1.5.4 Figure 3-3 is an input-output diagram of the S-45, table 3-7 lists the characteristics, and table 3-8 lists the front-panel control functions.

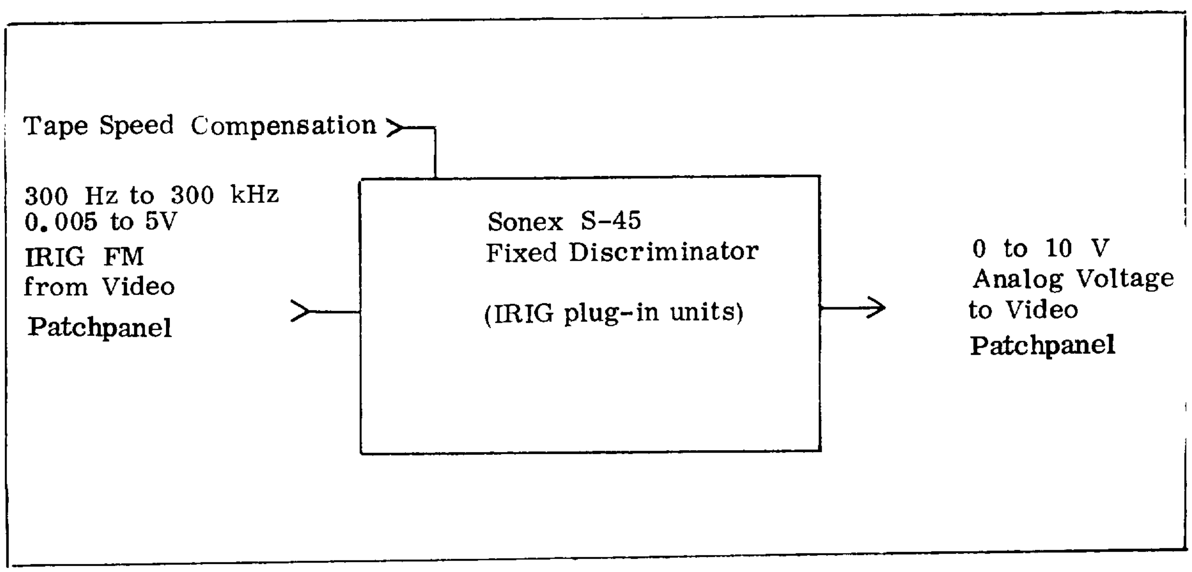


Figure 3-3. Sonex S-45 Fixed Discriminator Input-output Diagram

Table 3-7. Sonex S-45 Discriminator Characteristics

Parameter	Characteristics
Input	10 V maximum.
Input Impedance	50 kΩ on lowest range; 25 kΩ on all other ranges.
Ranges	0.03, 0.1, 0.3, 1, 3, and 10 Vrms.
Accuracy	±5% of full scale from 300 Hz to 200 kHz.
Output	±5 V (nominal).

Table 3-8. Sonex S-45 Discriminator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
Power Supply		
ON/OFF switch	ON	Turns on unit.
Meter Unit		
RANGE switch	.02 .1 .3 1 3 10	Input meter range switch.
Discriminator		
Pushbutton	Momentary press	Applies band pass filter output to meter unit.
DEV switch	+ -	Changes dc output polarity.
▼ CA/CD switch	CA CD	Selects output filter characteristics.
▼Specified in NOSP.		

3.1.6 EMR 229 TUNABLE DISCRIMINATOR

The FM multiplex from a receiver or magnetic tape system is applied to a tunable bandpass filter of the discriminator. The discriminator can be tuned by front-panel controls to accept the desired subcarrier. Two versions of the EMR 229 are available, designated Model 229A-01 or Model 229A-02. Model 229A-01 provides a frequency tuning range of 100 Hz to 100 kHz and Model 229A-02 provides a tuning range of 300 Hz to 300 kHz. Figure 3-4 is an input-output diagram, table 3-9 contains the characteristics, and table 3-10 lists the front-panel control functions.

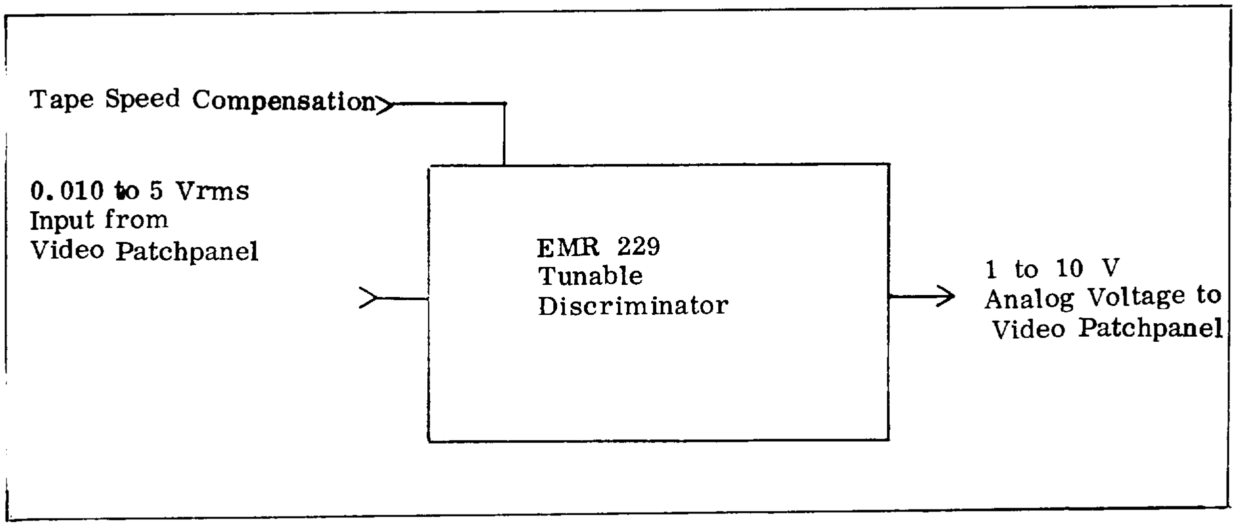


Figure 3-4. EMR 229 Tunable Discriminator Input-Output Diagram

Table 3-9. EMR 229 Tunable Discriminator Characteristics

Parameter	Characteristics
Input Impedance	Greater than 100 kΩ.
Dynamic Input Signal Range	10 mVrms to 5 Vrms.
Subcarrier Frequency Deviation	±7.5 or ±15%, switch selectable.
Output Noise	RMS value of less than 0.2% of full bandwidth voltage.
Output Voltage	1 to 10 V.
Output Current	100 mA capability from dc to 5 kHz, decreasing linearly to 50 mA at 30 kHz.
Output Impedance	2Ω or less at bandedge output of 10 V, decreasing linearly to 0.2Ω or less at 1 V.
Harmonic Distortion	For deviation ratios of 5 or more and with modulation extending from band-edge to bandedge, 1% or less for any modulation frequency up to the cutoff frequency of the channel.

Table 3-10. EMR 229 Tunable Discriminator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
Power Supply		
METER RANGE switch	0.1 0.3 1 3 10	Meter range selector.
ON/OFF switch	ON OFF	Turns on unit.
Discriminator		
BANDEDGE VOLTS control	Variable	Adjusts dc output voltage.
Tunable Channel Selector/ Filter		
LOOP WIDTH control	1 5 10 25 50 100	Adjusts phase-lock loop time constant.
▼ CENT. FREQ. MULT. switch	.1* 1 1* 10 10* 100	Selects input frequency ranges.
▼ CENT. FREQ. KC control	Variable 3 to 10*	Selects input carrier center frequency.
▼ BANDWIDTH switch	7.5% 15%	Selects input bandwidth.
BALANCE control	Variable	Sets dc operating level.
▼ CUT OFF FREQ. MULT. switch	1* 10 10* 100 100* 1K 1K* 10K	Selects output filter frequency ranges.
▼ CUT OFF FREQUENCY C.P.S. control	Variable 3 to 10*	Selects output filter cutoff.
▼ OUTPUT RESPONSE switch	CA CD	Selects output filter response, either constant amplitude or constant delay.

* Red numbers. Controls are color coded to correspond with freq variable dials.
▼ Specified in NOSP.

3.1.7 EMR 4140 TUNABLE DISCRIMINATOR

The EMR 4140 is designed to process analog or pulse data contained in an FM subcarrier channel. The FM subcarrier center frequencies, deviations, and data cutoff frequencies are manually tunable at the front panel or remotely programmable from an external source. The discriminator has the following operating characteristics:

3.1.7.1 Frequency range: 100 Hz to 1.5 MHz.

3.1.7.2 Center frequency deviations: ±7.5, ±15, ±20, ±30, and ±40 percent.

3.1.7.3 Output data cutoff frequencies: 1 Hz to 300 kHz.

3.1.7.4 Dynamic input range: 0.010 to 5 Vrms.

3.1.7.5 Output voltage: single-ended and referenced to ground.

3.1.7.6 Figure 3-5 is an input-output diagram of the EMR 4140, table 3-11 contains the characteristics, and table 3-12 lists the front-panel control functions.

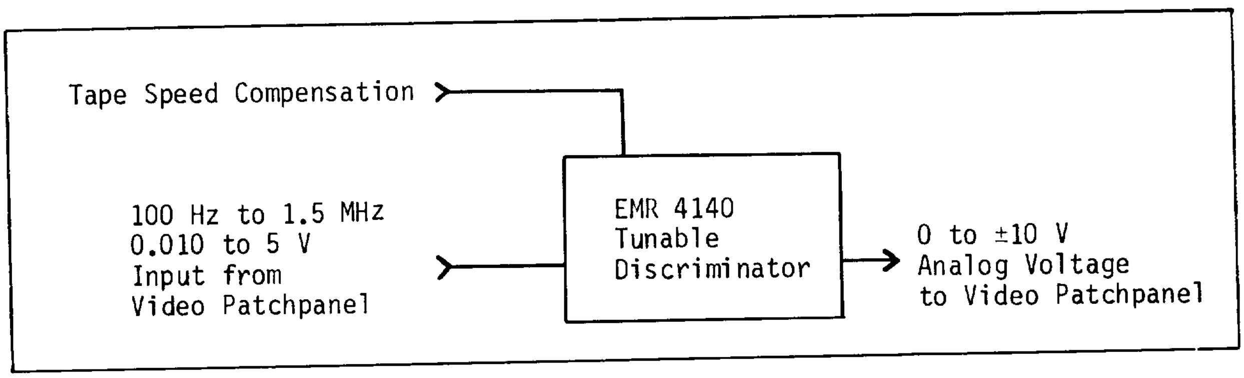


Figure 3-5. EMR 4140 Tunable Discriminator Input-output Diagram

Note

It is recommended that the 4140 discriminator not be used to process PDM data due to the sharp cutoff of the output filter. The EMR 229 tunable discriminator should be used instead.

Table 3-11. EMR 4140 Tunable Discriminator Characteristics

Parameter	Characteristics
Input Impedance	Greater than 100 kΩ shunted by less than 30 pF capacitance.
Dynamic Input Signal Range	10 mV to 5 Vrms for subcarrier frequencies up to 300 kHz. Minimum input signal increases linearly to 50 mVrms for frequencies from 300 kHz to 1.5 MHz.
Subcarrier Frequency Deviations	±7.5%, ±15%, ±20%, ±30%, and ±40%, switch selectable.
Output Noise	For deviation ratios of 5 or greater, the output noise will be less than 0.1% of bandwidth at center frequencies up to 300 kHz, less than 0.2% of bandwidth above 300 kHz.
Output Voltage	0 to ±10 V.
Output Current	200 mA from dc to 50 kHz; 100 mA from 50 kHz to 100 kHz; 50 mA above 100 kHz.
Output Impedance	Less than 2 Ω to 10 kHz, increasing linearly to a maximum of less than 10 Ω at 300 kHz.
Harmonic Distortion	Less than 1% for any modulation frequency up to channel cutoff frequency.

Table 3-12. EMR 4140 Tunable Discriminator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON	Turns on unit.
BALANCE control	Variable	Sets dc operating level.
▼ CENTER FREQUENCY AND RANGE control	Variable	Selects center frequency of received carrier.
▼ DATA CUT-OFF AND RANGE control	Variable	Selects cutoff frequency of output filter.
▼ RESPONSE switch	CA CD	Selects output filter mode of constant amplitude or constant delay.
▼ DEVIATION switch	±7.5 ±15 ±20 ±30 ±40	Selects input bandwidth (percent deviation).
BAND EDGE VOLTS control	Variable	Adjusts output voltage.
CONTROL switch	LOCAL REMOTE	Selects local or remote operation by a computer.

▼ Specified in NOSP.

3.1.8 TRICOM MODEL 482 PHASE-LOCK DISCRIMINATOR

3.1.8.1 The Model 482 discriminator uses all solid-state, primarily integrated circuitry which contributes to a high degree of stability. Its construction is modular, allowing for ease in maintenance and for the design of a system containing the exact number of channels required for each mission.

3.1.8.2 The discriminator is designed for rack installation and is mounted in a Model 401 module housing which occupies 3¼ in. in a standard 19-in. rack. This combination is a complete operational unit, requiring only system interconnection and a power source to become fully operational.

3.1.8.3 Each plug-in discriminator module is for a single discrete frequency or channel. The discriminator accepts as input FM analog data multiplexed from a remote source either directly through an RF link or from a magnetic tape.

3.1.8.4 Each module has a front-panel, plug-in, low-pass filter that, along with the channel selector chassis, determines the characteristics of the specific discriminator.

3.1.8.5 No special operating procedures are applicable. It is only necessary to ensure that the proper input and output connections are made and that the input signal level remains on scale when the meter function switch (S1) is set to SUB. Average subcarrier deviation is indicated by the meter when S1 is set to OUT. (Refer to table 3-12A for a list of front-panel controls, indicators, and test points. See figure 3-5A for an illustration of the Model 482 phase-lock discriminator.)

Table 3-12A. Tricom Model 482 Phase-lock Discriminator Controls, Indicators, and Test Points

Control/Indicator	Position	Purpose
	Model 482B Channel Selector Module	
ZERO (R62)	Adjustable	Adjusts subcarrier output of discriminator to 0 for designated center frequency.
Test Points:		
IN (TP1)	NA	Bandpass output.
GND (TP0)	NA	Chassis ground.
	Model 482P Discriminator Chassis Module	
MUX/SUB/OUT (S1)	Selectable	Meter function switch selects the parameter to be indicated by M1.
	MUX	Indicates RMS value of total multiplex on a logarithmic scale from 5 mV to 5 V.

Table 3-12A. Tricom Model 482 Phase-lock Discriminator Controls, Indicators, and Test Points (cont)

Control/Indicator	Position	Purpose
	SUB	Indicates RMS value of output of bandpass filter for selected channel on a logarithmic scale from 5 mV to 5 V.
	OUT	Is proportional to output of discriminator with 0 V at center, upper bandedge deviation at top of scale, lower bandedge at the bottom. Is independent of the deviation polarity.
Meter (M1)	NA	Indicates voltage for function selected by S1.
GAIN control (R54)	Adjustable	Controls output voltage 0 to 10 V for bandedge deviation.
OUT (TP1)	NA	Indicates voltage proportional to output of discriminator varying with the setting of R54.
GND (TP0)	NA	Chassis ground.

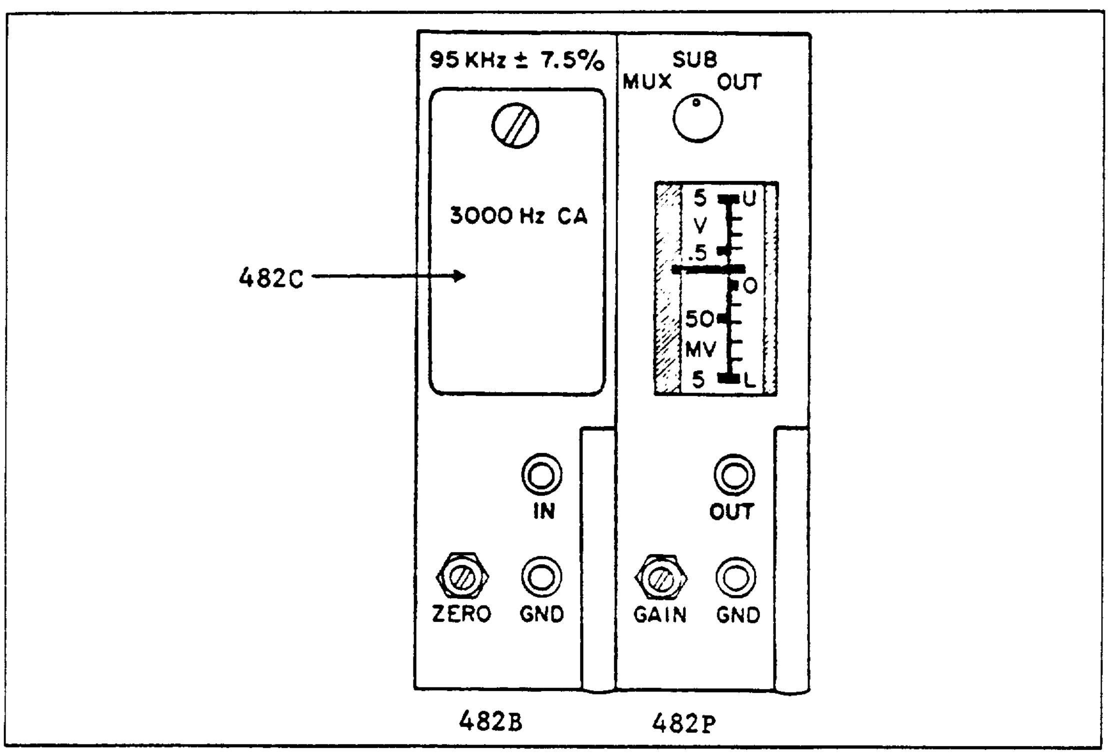


Figure 3-5A. Model 482 Phase-lock Discriminator, View of Front Panel with Standard Low-pass Filter

3.2 SUBCARRIER OSCILLATORS

3.2.1 GENERAL

The subcarrier oscillators are used to provide frequency division multiplexed carriers. The composite outputs are used for data recording, data remoting, and station testing. FM, FSK, and PSK outputs may be obtained depending on which subcarrier oscillators are used.

3.2.2 EMR 4900 SUBCARRIER OSCILLATOR

The EMR 4900 subcarrier oscillator will generate up to four composite FM telemetry signals using standard IRIG subcarriers. It contains up to 36 IRIG VCO's and each one may in turn be switched in or out of four self-contained mixers. Figure 3-6 is an input-output diagram, table 3-13 lists equipment characteristics, and table 3-14 lists the front-panel control functions.

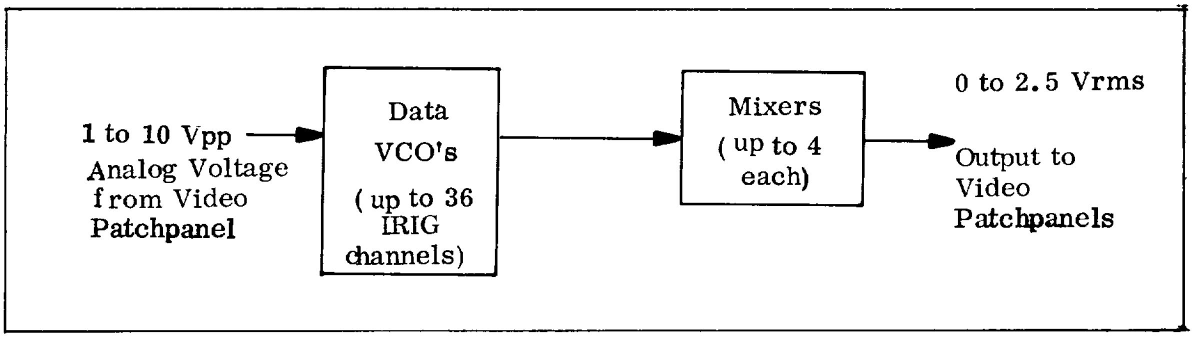


Figure 3-6. EMR 4900 Subcarrier Oscillator Input-Output Diagram

Table 3-13. EMR 4900 Subcarrier Oscillator Characteristics

Parameter	Characteristics
Input Voltage	±2.5 V, 0 to -10 V, 0 to +10 V.
Subcarrier Frequencies	400 Hz to 70 kHz.
Input Voltage Offset	±5 V.
Linearity	0.1% of full bandwidth.
Output Impedance	50 kΩ (nominal).
Output Voltage	Adjustable to 2.5 V.
Frequency Stability	Less than 0.25%.

Table 3-14. EMR 4900 VCO/Mixer Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER SUPPLY switch	<u>ON</u> OFF	Turns unit on.
INPUT SELECTOR VCO 1-18 switch	<u>NORM</u> CAL SINE WAVE SQ WAVE SPL	Selects VCO signal input for VCO's 1-18.
INPUT SELECTOR VCO 19-36 REF switch	<u>NORM</u> CAL SINE WAVE SQ WAVE SPL	Selects VCO signal input for VCO's 19-36.
CALIBRATOR SELECTOR switch	INT EXT AUTO	Selects source of calibrator voltage.
CALIBRATOR VOLTAGE switch	-10 -7.5 -5 -2.5 0 +2.5 +5 +7.5 +10	Selects internal calibration voltage.
OUTPUT MONITOR switch	All chan 1-36 plus REF and MIXERS 1-4	Monitors carrier output as selected to a front-panel jack.
▼VCO 1 through 36 (36 switches)	1 2 3 4 OFF	Selects VCO output to one of four mixers, or OFF.
▼REF VCO switch	1 2 3 4 OFF	Selects ref VCO output to one of four mixers, or OFF.
▼Specified in NOSP.		

3.2.3 SONEX AMPLIFIER AND OSCILLATORS

3.2.3.1 Sonex S-24 Voltage Controlled Oscillator. This module plugs into the Sonex S-23 rack-mounted chassis. Input and output connections are shown in figure 3-7. The characteristics of this equipment are described in table 3-15 and front-panel control functions are described in table 3-16.

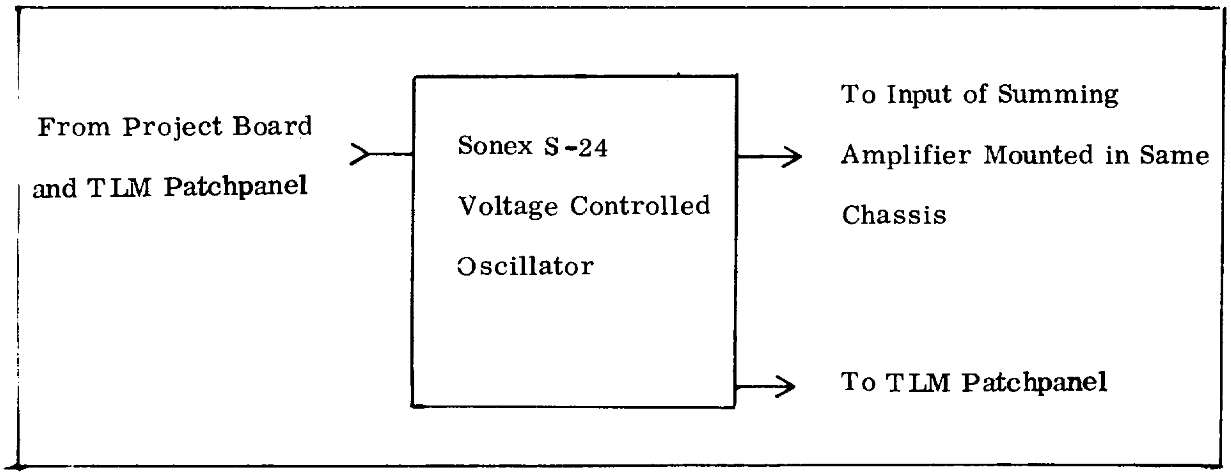


Figure 3-7. Sonex S-24 VCO Input-output Diagram

Table 3-15. Sonex S-24 VCO Characteristics

Parameter	Characteristics
Center Frequency	300 Hz to 1.2 MHz.
Deviation Sensitivity	
S-24-01	Peak deviation of ±1 to ±40 % as determined by channel selector for a peak input of ±1 to ±10 V as determined by the SENS control.
S-24-03	Peak deviation of ±1 to ±40% as determined by channel selector for a peak input of ±1 to ±10 V or 0 to ±20 V or 0 to +20 V as determined by the offset switch and the SENS control.
Deviation Limit	Limit to 140% of bandedge.
Deviation Polarity	Positive.
Input Impedance	100 kΩ in parallel with 47 pF max.
Modulation Bandwidth	Dc to 300 kHz as determined by the channel selector.
Modulation Distortion	Less than 0.5% total harmonic distortion for frequencies less than 50 kHz, increasing to 1 % at 300 kHz.
Linearity	±0.05 % of bandwidth.
Stability	±0.05% of center frequency for 15 hours after a 10-minute warmup.
Output	1 kΩ and 50Ω . Open circuit voltage of both outputs is adjustable to a nominal 2 Vrms. Maximum output current is 10 mA. The output is short circuit proof.
Output Amplitude Modulation	Less than 10 % for channels with less than ±16 % deviation.

Table 3-16. Sonex S-24 VCO Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
SENS control		Adjusts the frequency deviation for a given input signal level. Adjust for upper bandedge frequency with upper deviation limit input voltage.
FREQ control		Adjusts the frequency. Adjust for center frequency with zero volt input if a balance input signal will be used. Adjust for lower bandedge with lower deviation limit input voltage if an unbalanced input signal will be used.
AMPL control		Adjusts output amplitude level. (The level at the OUT test point is not controlled by the AMPL control.)
ON/OFF switch (S-24-01 model only)	<u>ON</u> OFF	Turns subcarrier off for system adjustments.
▼ OFF/±2.5/0-5 switch (S-24-03 model only)	OFF ±2.5 0-5	Permits operation of the unit with either balanced or zero-positive input signals. OFF position turns subcarrier off for system adjustments.

▼ Specified in NOSP.

3.2.3.2 Sonex S-30 Reference Oscillator

a. The purpose of the reference oscillator is to provide a stable reference frequency signal for tape-speed error compensation. The reference signal is added to the subcarrier multiplex prior to tape recording.

b. The Sonex S-30 Reference Oscillator plugs into the Sonex S-23 rack-mounted chassis. Output connections are shown in figure 3-8. The characteristics of the S-30 are described in table 3-17 and front-panel controls are described in table 3-18.

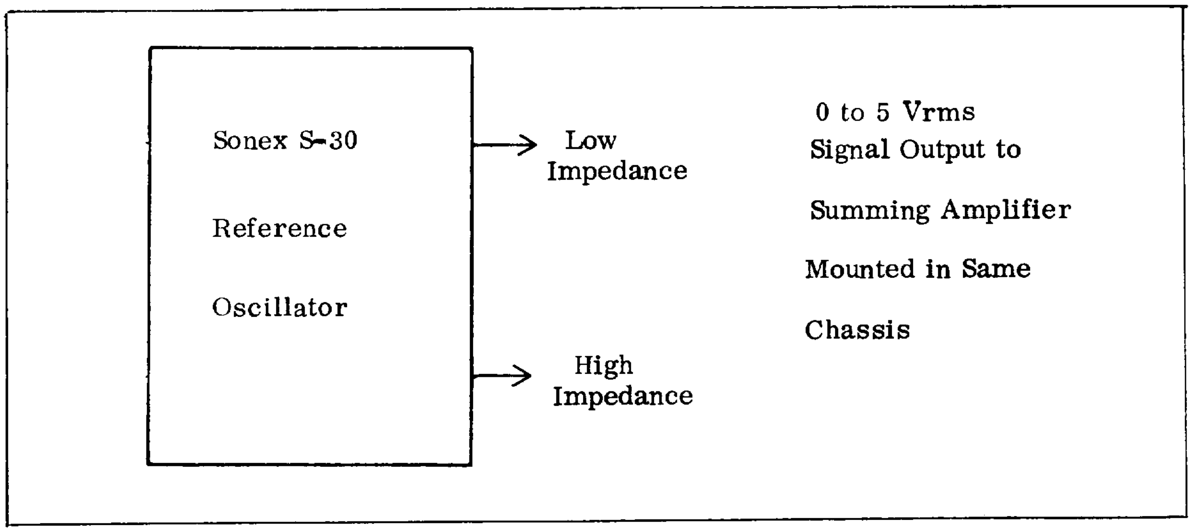


Figure 3-8. Sonex S-30 Reference Oscillator Output Diagram

Table 3-17. Sonex S-30 Reference Oscillator Characteristics

Parameter	Characteristics
Frequency	10 kHz to 1 MHz.
Accuracy	±0.01 %.
Stability	±0.01 %.
Output Level	0 to 5 Vrms open circuit.
Output Current	10 mA. The output is short-circuit proof.
Harmonic Distortion	Less than 1 % total.
Output Impedance	50Ω and 1 kΩ.

Table 3-18. Sonex S-30 Reference Oscillator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
LEVEL control		Controls output voltage level.
100 KC/OFF switch (S-30-01 model only)	100 KC OFF	Selects output reference frequency in the 100 KC and 50 KC positions. In the OFF position the input to the output amplifier is grounded.
100 KC/50 KC/OFF switch (S-30-02 model only)	100 KC 50 KC OFF	

3.2.3.3 Sonex S-29 Summing Amplifier. This module plugs into the Sonex S-23 rack-mounted chassis. Input and output connections are shown in figure 3-9. The characteristics of this equipment are described in table 3-19 and front-panel controls are described in table 3-20.

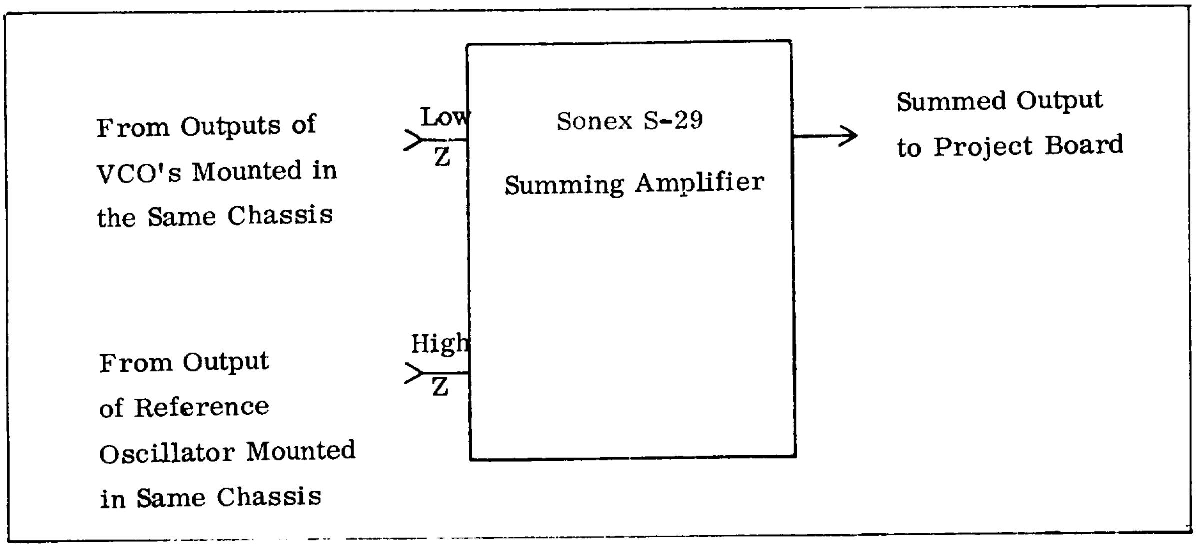


Figure 3-9. Sonex S-29 Summing Amplifier Input-output Diagram

Table 3-19. Sonex S-29 Summing Amplifier Characteristics

Parameter	Characteristics
Frequency	300 Hz to 2 MHz at a gain of 5 or less. 300 Hz to 1 MHz at a gain of 10.
Input Impedance	Input No. 1: 3 kΩ min. Input No. 2: 10 kΩ .
Gain	0.5 to 10.
Deemphasis (S-29-01 model only)	Reduces the gain of input No. 1 above the frequency selected at a 6 dB/octave rate.
Intermodulation Distortion	Less than 0.25% for frequencies less than 100 kHz, increasing to less than 1% at 2 MHz.
Output Voltage	20 Vpp open circuit.
Output Current	100 mA.
Output Impedance	50 Ω.

Table 3-20. Sonex S-29 Summing Amplifier Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
FINE control		Permits gain adjustment of input No. 1 to the maximum selected with the GAIN switch. Set for required amplifier gain.
GAIN switch	0.5 1 2 5 10	Selects maximum gain of amplifier for both inputs. Set for required maximum amplifier gain, or per NOSP if specified.
▼ DE-EMP switch (S-29-01 model only)	OFF 1 3 10 30 SP	Selects deemphasis corner frequency.

▼ Specified in NOSP.

3.2.3.4 Programmable Voltage Controlled Oscillator Model 6009. The Reaction Instruments Model 6009 is a multimode signal generator that can operate autonomously by front-panel control or, alternatively, can be controlled by digital signals from a remote computer. In the normal mode, the center frequency is frequency modulated by an analog signal applied to the input. Center frequency and percent deviation are controlled in the generator, and deviation of frequency from the center value is determined by the input signal. In the frequency-shift-keyed (FSK) mode, the output rapidly switches between two frequencies which have been selected by front-panel or computer control. It can be phase-locked to an external reference signal and can also audio mix its output with an externally applied signal. The output level is adjustable from 0.1 to 5 V. Although the specified center frequency range is 100 Hz to 2.5 MHz, it can be set (front panel) or programmed (computer) from 1.0 Hz to 9.99 MHz if relaxed output tolerances are acceptable. Figure 3-10 is a block diagram, table 3-21 contains characteristics, and table 3-22 lists the front-panel control functions.

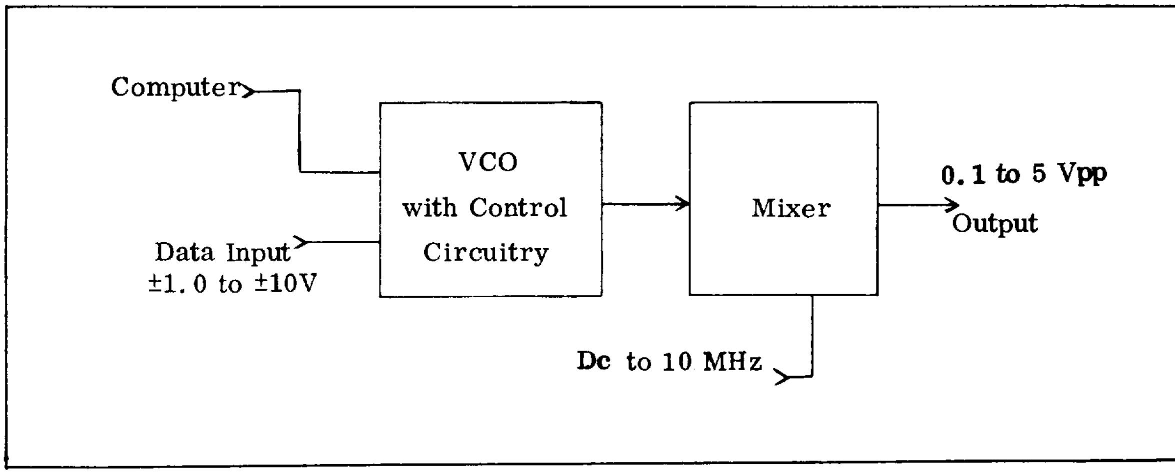


Figure 3-10. Programmable VCO 6009 Input-output Diagram

Table 3-21. Reaction Instruments Programmable VCO Model 6009 Characteristics

Parameter	Characteristics
Input Voltage	1.0 to 10V peak.
Frequency Range	100 Hz to 2.5 MHz.
Center Frequency Stability	Less than ±0.05% drift.
Output Amplitude	0.1 to 5.0 V peak.

Table 3-22. Model 6009 PVCO Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON (Lit)	Turns unit on.
OUTPUT VOLTS control	0 1 2 3 4 5	Adjusts VCO output level.
INPUT RANGE switch	± 1 V ± 2.50 ± 5 V ± 10 V	Adjusts input sensitivity.
INPUT RANGE control	Variable	Variable input adjust.
▼ FO/FSK A control	Variable	Selects output frequency.
▼ % DEV/FSK B control	Variable	Selects output deviation.
OFFSET switch	ZERO UBE LBE	Provides fixed offset voltage.
OFFSET control	Variable	Provides variable offset voltage.
LOCAL/REMOTE switch	LOCAL REMOTE	Selects either front panel or computer control.
▼ NORMAL/FSK switch	NORMAL FSK	Selects either FM or FSK operation.
▼ DEVIATION POLARITY switch	POSITIVE NEGATIVE	Selects direction of frequency change with input polarity.

▼Specified in NOSP.

3.2.3.5 Reaction Instruments Model 6057 FM Multiplexer-VCO Calibrator. The Model 6057 is a completely self-contained FM subcarrier generator and multiplexer system with built-in modules for test and calibration. It contains 25 VCO's, each of which may be programmed to any one of four mixer amplifiers. In addition, each of the mixer amplifiers can accept up to five externally applied input signals. Figure 3-11 is an input-output diagram, table 3-23 lists the electrical characteristics, and table 3-24 lists the front-panel control functions.

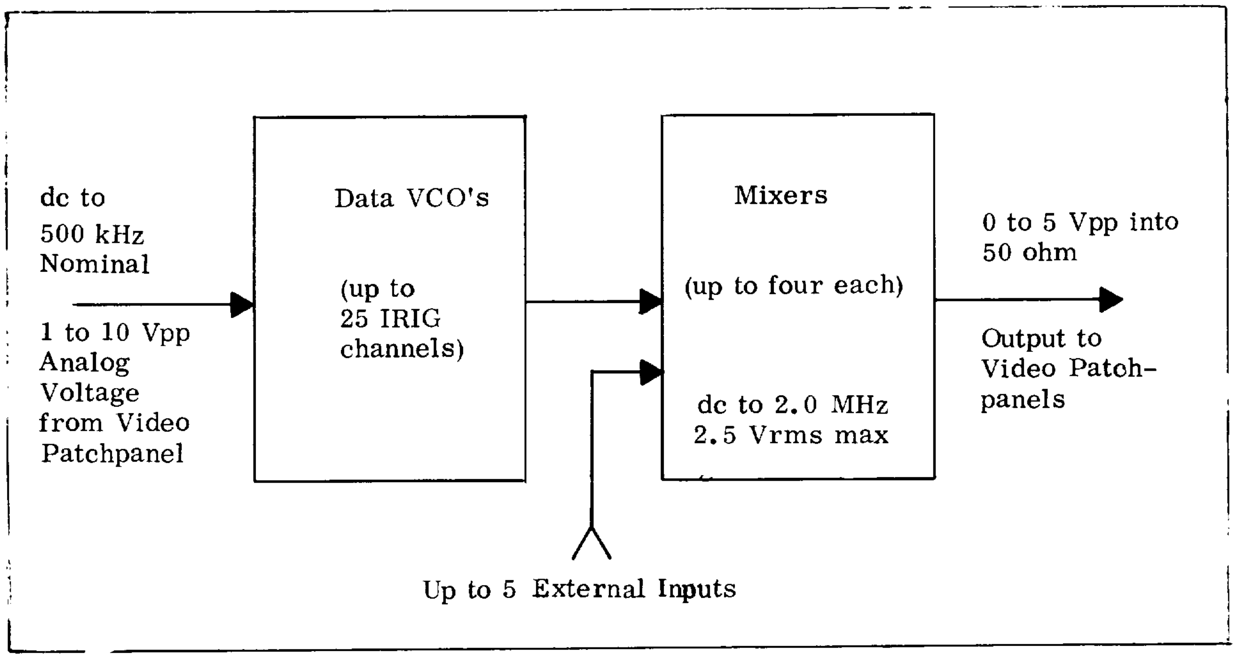


Figure 3-11. Reaction Instruments Model 6057 FM Multiplexer - VCO Calibrator Input-output Diagram

Table 3-23. Reaction Instruments Model 6057 FM Multiplexer-VCO Calibrator Characteristics

Parameter	Characteristics
Primary power requirements	108 to 132 Vac, 57 to 63 Hz, less than 2 A.
Data input signals	Data input may be from 1 to 10 Vpp over the range from dc to 500 kHz.
External FM input signals	Input signals may be up to a maximum of 2.5 Vrms over the range from dc to 2.0 MHz.
External reference input	External reference signal from the frequency counter unit should be a 1-MHz sine wave, 1 Vrms into 50 ohms.
Mixer amplifier output	Adjustable output amplitude from 1 to 10 Vpp open circuit; rated at 5 Vpp into 50 ohms. Frequency range from dc to 2.0 MHz.
Calibrator voltage output	Nine separate output voltages from -5 V to +5 V in 1.25-V increments. Front-panel OFFSET control shifts range from -10 V to 0 or from 0 to +10 V. Voltages are accurate to ±1 mV.
VCO specifications	Full-scale deflection with data input variations of ±5 V. Input signal may be offset -5 V, 0 V, or +5 V. Front-panel switch is used to select either positive or negative deviation polarity. Output voltage adjustable from 0.1 to 1.0 Vrms.
Dual mixer amplifier specifications	Frequency range from dc to 2.0 MHz ±5 dB for all gain settings. Harmonic distortion less than 1%. Intermodulation level in any channel at least 45 dB below the center frequency of adjacent channels.
VCO calibrator specifications	Front-panel selected automatic mode provides calibration voltages in ascending or decending sequence with 1-, 2-, or 5-second dwells. All calibration voltages are available on rear connector. Unit may be operated with a remote control/indicator panel.

Table 3-23. Reaction Instruments Model 6057 FM Multiplexer-VCO Calibrator Characteristics (cont)

Parameter	Characteristics
Voltmeter specifications	Front-panel controls are used to select any VCO input, VCO output, or mixer amplifier output for voltage monitoring. Unit automatically measures ac and dc voltages with automatic dc polarity sensing and meter reversal.
Frequency counter specifications	Front-panel controls are used to monitor any VCO output signal or external VCO signal. May be used with internal or external 1-MHz frequency standard. Measured frequency is displayed on seven-digit front panel.

Table 3-24. Reaction Instruments Model 6057 FM Multiplexer-VCO Calibrator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Two position toggle switch with associated indicator. Used to apply and remove primary ac power to the system. Indicator will light when switch is ON and rear-panel fuse is continuous.
▼ Voltage Controlled Oscillator MIXER switch	1 2 3 4 OFF	Connects the VCO output to one of four different mixers. When a particular VCO unit is not used, the switch is set to the OFF position.
OFFSET switch	-5V 0 +5V	Provides either a ±5 V or 0 V offset to the external modulating signal.
POL switch	-/+	Selects either a positive or a negative polarity sense to the external modulating signal.
V_{in} potentiometer		Screwdriver adjusted, variable resistor. Adjusts the modulating signal amplitude so that bandedge frequency is obtained on the peak signal amplitude.
F_o potentiometer		Screwdriver adjusted, variable resistor. Fine tunes the center frequency output signal of the VCO.
V_{out} potentiometer		Screwdriver adjusted, variable resistor. Adjusts the amplitude of the VCO output signal.
Dual Mixer Amp GAIN (1), GAIN (2)		Ten-turn, precision wound resistor. Selects the desired gain of the mixer amplifier unit for the channel circuit.
External Input ▼ INPUT 1 switch	1 2 3 4 OFF	Connects the indicated external input to one of four different mixer amplifier circuits and is set at OFF when a particular input is not used.
▼ INPUT 2 switch		Same as INPUT 1.

▼ Specified in NOSP.

Table 3-24. Reaction Instruments Model 6057 FM Multiplexer-VCO Calibrator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
▼ INPUT 3 switch		Same as INPUT 1.
▼ INPUT 4 switch		Same as INPUT 1.
▼ INPUT 5 switch		Same as INPUT 1.
<u>Calibrator</u> UBE → LBE LBE → UBE	UBE → LBE LBE → UBE	Selects either the upper or the lower bandedge as the starting point for the automatic sequencing mode.
LCL/RMT	LCL RMT	Places the calibrator either under local (front panel) or remote control.
INT/EXT switch	INT EXT	Connects the calibrating voltage to either the 25 VCO modules (INT), or to a separate rear-panel connector (EXT) for external applications.
1/2/5/MANUAL/DATA switch	1 2 5 MANUAL DATA	Selects the operating mode for the calibrator module. The 1, 2, and 5 positions are used to select dwell times of 1, 2, or 5 sec in the automatic mode. MANUAL permits manual selection of the calibrate voltages. Set at DATA for normal system operation.
OFFSET switch	-5V 0 +5	Offsets the selected calibration voltage by -5, 0, or +5 V.
UBE/2/3/4/5/6/7/8/LBE PBI's	Selectable	Used to manually select the calibrating voltage at values from +5 to -5 V in 1.25-V increments.
<u>Frequency Counter</u> VCO (S-1) switch	00 10 20 MIXER	Used in conjunction with switch S-2 to select a particular VCO unit or mixer unit for frequency monitoring. 00, 10, and 20 are used to select VCO units 1 through 9, 10 through 19, and 20 through 25, respectively.

▼ Specified in NOSP.

Table 3-24. Reaction Instruments 6057 FM Multiplexer-VCO Calibrator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Frequency Counter (cont) VCO (S-2) switch	Selectable 0 through 9	Used in conjunction with switch S-1 to select a particular VCO or mixer input for frequency monitoring.
REF switch	INT EXT	Selects either the internal 1-MHz frequency standard or an externally applied 1-MHz standard
Voltmeter VCO OUTPUT VCO INPUT (S-2) switch	00 10 20 MIXER 00 10 20	Used in conjunction with switch S-1 to select either the VCO outputs, the mixer outputs, or the VCO inputs for voltage monitoring. 00, 10, and 20 are used to select VCO circuits from 1 through 9, 10 through 19, and 20 through 25, respectively.
(S-1) switch	Selectable 0 through 9	Used in conjunction with switch S-2 to select a particular VCO or mixer amplifier circuit for voltage monitoring.

3.3 PSK SIGNAL DEMODULATOR AND SIMULATOR

3.3.1 MODEL 329 PSK DEMODULATOR

The Model 329 PSK demodulator detects any PSK-modulated subcarrier from 1 kHz to 2 MHz. The unit demodulates the subcarrier, reconstructs the serial PCM data, produces a clock output, and supplies data and subcarrier clock to the bit synchronizers. The input and output characteristics are as follows:

a. Input data: 0.2 to 10 Vpp.

b. Output data: 1 to 10 Vpp variable.

Figure 3-12 is a block diagram of the Model 329 demodulator, table 3-25 lists equipment characteristics, and table 3-26 lists the front-panel control functions.

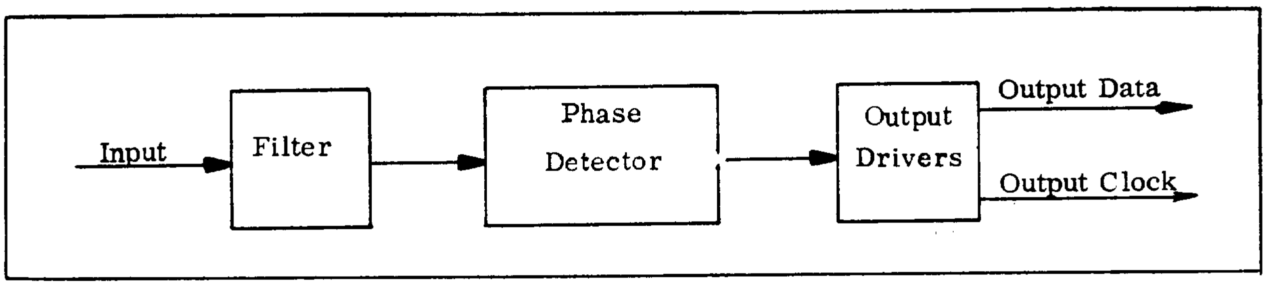


Figure 3-12. Model 329 PSK Demodulator Block Diagram

3.3.2 MODEL 329A BPSK DEMODULATOR

The Model 329A biphase, shift-keyed demodulator detects any PSK-modulated subcarrier from 1 kHz to 4 MHz. The unit demodulates the subcarrier, reconstructs the serial PCM data, produces an SC clock output, and supplies data to the bit synchronizer. The input and output characteristics are as follows:

a. Input data: 0.01 to 1.0 Vpp.

b. Output data: 1.0 Vpp fixed.

Figure 3-12A is a block diagram of a Model 329A demodulator. Table 3-25A lists equipment characteristics; table 3-26A lists the front-panel control functions.

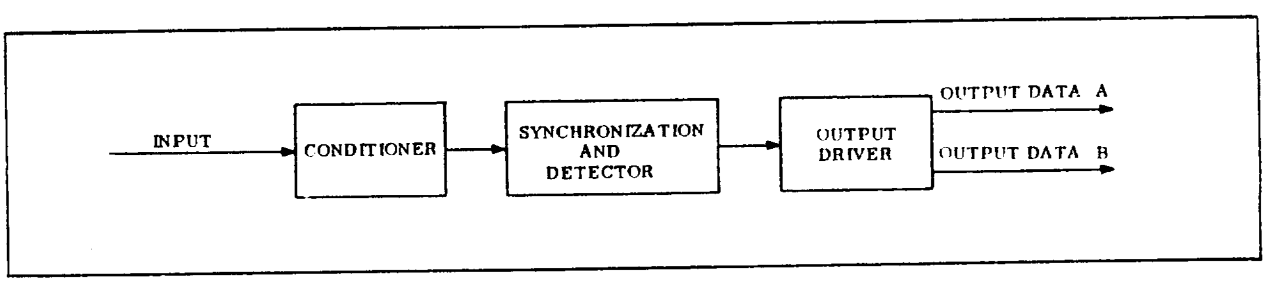


Figure 3-12A. Model 329A BPSK Demodulator Block Diagram

Table 3-25. Model 329 PSK Demodulator Characteristics

Parameter	Characteristics
Signal Input	1 kHz to 2 MHz.
Bandwidth	1 Hz to 2 MHz.
Input Impedance	50 ohm.
Input Level	0.2 to 10 Vpp.
Input Selections	Five input sources, switch selectable.
Output A-1	0.25 to 5 Vpp composite signal and noise.
Demod Output	1 to 10 V variable.

Table 3-25A. Model 329A BPSK Demodulator Characteristics

Parameter	Characteristics
Signal Input	1 kHz to 4 MHz.
Data Bandwidth	100 Hz to 4 MHz.
Input Impedance	50 ohms, or 20 Kohms.
Input Selection	Five input sources, switch selectable.
Input Level	0.01 to 1.0 Vpp (ac coupled).
Demod Data Outputs	1.0 Vpp fixed.

Table 3-26. Model 329 PSK Demodulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Turns on unit.
RESET switch	Momentary press	Grounds loop.
TEST switch	Momentary press	Applies internal signal to demod.
▼TRACKING switch	1% 10%	Sets tracking bandwidth of loop.
LOOP BAND switch*	1, 2, 3	Sets loop bandwidth.
SOURCE switch	1-5	Selects input signal from one of five input connectors.
OUTPUT control	Variable	Sets video output level.
▼EXT/INT switch	EXT INT	Selects internal or external bandpass filter.
▼BANDWIDTH (HZ) control	Variable	Selects output filter bandpass.
▼SUBCARRIER (HZ) control	Variable	Sets VCO frequency.
▼Specified in NOSP.		

*Operator option; permits optimization of loop bandwidth.

Table 3-26A. Model 329A BPSK Demodulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Turns on unit.
▼1.561 MHz/1.250 MHz 1.024 MHz/VAR switches	Variable	Selects crystal VCO frequencies, or, when set to VAR selects tunable subcarrier switches S9 through S13.

Table 3-26A. Model 329A BPSK Demodulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
▼ SUBCARRIER switches	Variable	Sets VAR VCO frequency.
VERNIER control	Variable	Fine adjustment for phase error voltage when unit is in lock.
SOURCE switch	Variable	Selects input signal from one of five input connectors.
CAL/RESET switch	Momentary press	Calibrates VCO and resets loop filter.
▼ LOOP BANDWIDTH switches	Variable	Selects loop bandwidth.
▼ DATA BANDWIDTH switches	Variable	Selects output filter bandpass.
▼ Specified in NOSP.		

3.3.3 MODEL 829 PSK SIMULATOR

The Model 829 PSK simulator generates an RF subcarrier which is PSK-modulated by an external PCM wavetrain input. Four independent subcarrier oscillators are available for use and may be multiplexed on one output. The oscillators are variable fron 1 Hz to 9.9 MHz. The simulator also contains a PCM code converter that accepts NRZ-L and can convert it to NRZ-M, NRZ-S, RZ, BiØ-L (SØ), BiØ-M, and BiØ-S for modulation of the PSK carrier. Figure 3-13 is a block diagram of the PSK simulator, table 3-27 lists equipment characteristics, and table 3-28 lists the front-panel control functions.

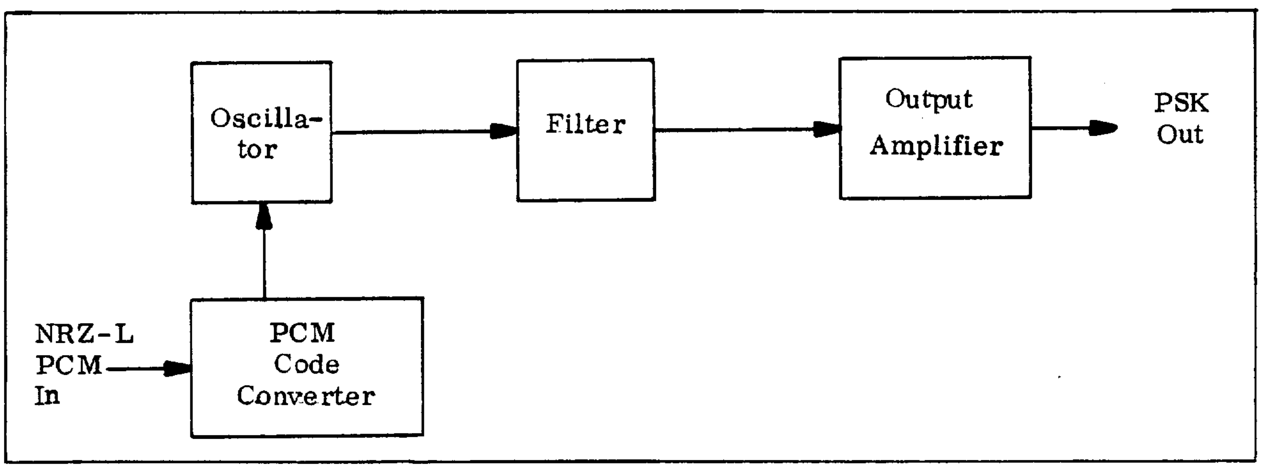


Figure 3-13. Model 329 PSK Simulator Block Diagram

Table 3-27. Model 829 PSK Simulator Characteristics

Parameter	Characteristics
Frequency Synthesizer	Four each, crystal controlled.
Frequency Range	1.0000 kHz to 1.9990 MHz.
Modulation	Subcarrier modulated by PCM wavetrain to produce PCM/PSK.
Output Voltage	0.5 to 4.0 V.
Rise/Fall Time	40 nsec max between 10 and 90% points.

Table 3-28. Model 829 PSK Simulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Turns unit on.
Channels 1, 2, 3, and 4		
NORMAL/INVERT switch	NORMAL INVERT	Data norm invert switch.
SOURCE switch	1 2 EXT	Selects PCM code converter 1, 2, or EXT input.
FILTER switch	IN OUT	Selects data filter.
INTL SC/EXT SC switch	INTL SC EXT SC	Selects internal or external subcarrier oscillator.
SUBCARRIER (HZ) control	Variable	Selects internal subcarrier oscillator frequency.
Data Filter		
BANDWIDTH (HZ) control	Variable	Selects data bandwidth for channel 1 only.
FREQ REF switch	INTL EXT	Selects internal or external reference frequency.

Table 3-28. Model 829 PSK Simulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
<u>Mixer</u>		
PSK CHANNELS (4 switches)	ON OFF 1-2-3-4	Enables the four SCO's to the mixer.
EXT CHANNELS (5 switches)	ON OFF 1-2-3-4-5	Accepts external signal inputs for mixing.
GAIN control	Variable	Sets mixer output level.
<u>Test</u>		
MONITOR SELECT switch	GND IN OUT DATA IN MOD OUT BPF OUT PSK EXT	Selects signal to be monitored on front-panel test point.
CHAN NO/EXT MIXER INPUTS switch	1 2 3 4 5	Selects external mixer inputs for monitoring.
<u>Data Code</u>		
SOURCE 1 switch	NRZ-L NRZ-M NRZ-S RZ BIØ-L BIØ-M BIØ-S	Selects PCM input code for code converter No. 1.
SOURCE 2 switch	NRZ-L NRZ-M NRZ-S RZ BIØ-L BIØ-M BIØ-S	Selects PCM input code for code converter No. 2.

3.4 DATA AMPLIFIERS

3.4.1 LINE DRIVERS

The purpose of these amplifiers is to provide one or more output signals from one input, and isolate the source from the loads. A typical application is between the output of the telemetry receiver and two tape recorder inputs.

3.4.2 AEROSCIENCE ELECTRONICS, INC. ADA-507 DATA AMPLIFIER

The ADA-507 Data Amplifier System consists of seven ADA-500 DC Data Amplifiers and seven ADA-500 Power Supplies installed in one E-507F Amplifier Enclosure. Figure 3-14 is an input-output diagram. Characteristics of the individual ADA-500 amplifiers with power supply are described in table 3-29. Front-panel controls are described in table 3-30.

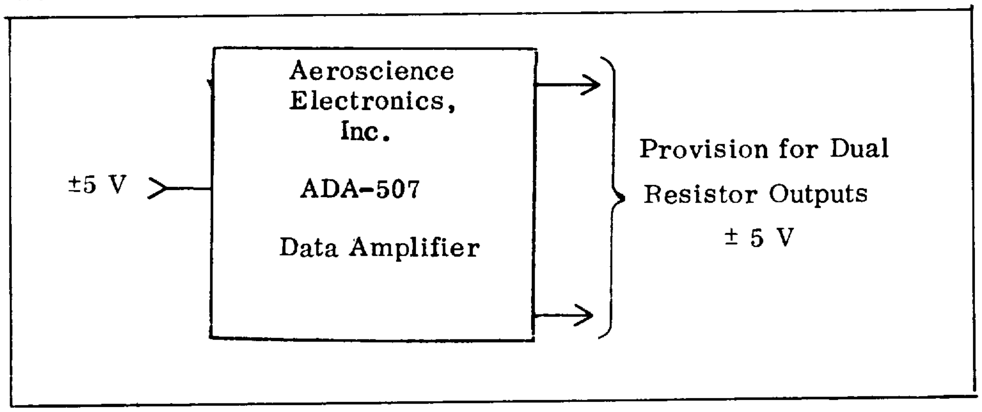


Figure 3-14. ADA-507 Data Amplifier Input-output Diagram

Table 3-29. Data Amplifier ADA-500, Assembly ADA-507 DC Characteristics

Parameter	Characteristics
Input Voltage	±5 V, single-ended.
Input Impedance	Approximately 150 kΩ resistance in parallel with 10 pF capacitance. (Terminals available for low-impedance input termination.)
Voltage Gain	0 to 4.5 adjustable.
Frequency Response	Dc to 1.5 MHz ±0.5 dB. Dc to 7 MHz ±3 dB.
Output Voltage	±5 V.
Output Impedance	Less than 1Ω . (Terminals available to obtain any higher desired output impedance. Provision made for dual, resistor-isolated outputs.)
Minimum Load Impedance	40Ω (including the effects of any internally inserted terminating resistors).

Table 3-30. ADA-500 Functional Data Amplifier Front-panel Controls, Indicator, and Nominal Settings

Control/Indicator	Position	Purpose
E-507F Amplifier Enclosure		
A.C. POWER	OFF ON	When set in ON position, applies ac power to amplifiers.
POWER-ON indicator		Lights red when ac power is turned on.
ADA-500 DC Data Amplifier		
GAIN control		Varies gain of amplifier.
ZERO control		Adjusts static (no signal) output of amplifier.

3.4.3 MODEL 2016 VIDEO DISTRIBUTION AMPLIFIER

The Model 2016 Video Distribution Amplifier functions to receive, process, amplify, and distribute video signals used in the TLM system. It receives a video signal of 0 to 10 Vpp with offsets up to ±2.5 Vdc. The frequency response is dc to 2 MHz ±0.5 dB. Output impedance is 10 ohms maximum. Figure 3-15 is a block diagram of the VDA, table 3-31 lists equipment characteristics, and table 3-32 lists the front-panel control functions.

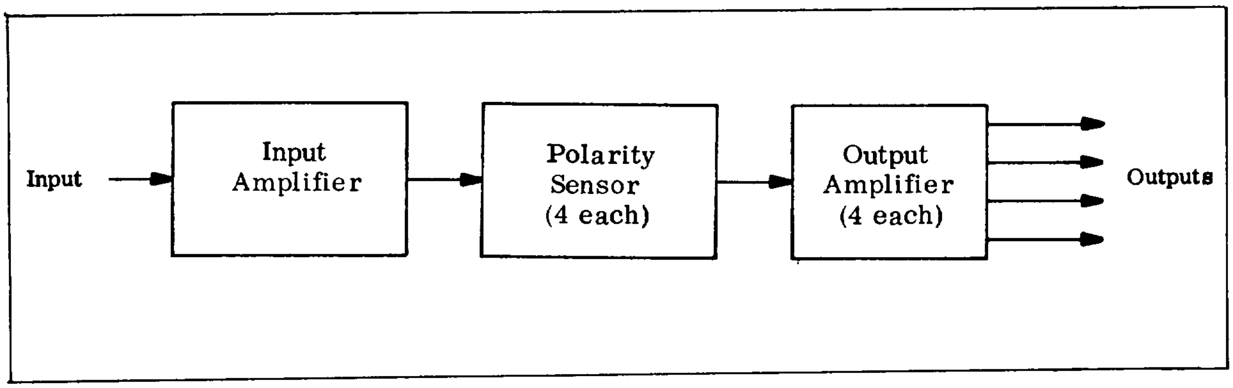


Figure 3-15. Model 2016 Video Distribution Amplifier Block Diagram

Table 3-31. Model 2016 Video Distribution Amplifier Characteristics

Parameter	Characteristics
Number of Input Signals	Four.
Number of Output Signals	Sixteen.
Input Impedance	100 kΩ .
Output Impedance	10Ω max.
Frequency Response	Dc to 2 MHz ±0.5 dB.
Sense Inversion Capability	Positive or negative.
Dynamic Range	0 to 10 Vpp.
Noise Output	5 mVrms max.

Table 3-32. Model 2016 Video Distribution Amplifier Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
Power Supply		
AC switch	ON OFF	Turns on unit.
TEST MONITOR switch	OFF CHAN A-1-2-3-4 CHAN B-1-2-3-4 CHAN C-1-2-3-4 CHAN D-1-2-3-4 VDC	Selects which VDA output will be displayed on the meter.
VDA's		
POWER switch	ON OFF	Turns on unit.
OFF SET ADJ switch	- 0 + Variable	Adjusts input offset for all channels.
SENSE (1 for each of four outputs) switch	- +	Sets output polarity.
GAIN ADJ (1 for each of the four outputs) control	Variable	Adjusts output level.

3.5 STDN SWITCHING SYSTEMS

3.5.1 GENERAL

3.5.1.1 STDN switching systems determine the routing of telemetry signals to auxiliary equipment for processing, recording, or display. Typical switching system block diagrams are shown in figures 3-16 and 3-17. All stations may not be configured as shown.

3.5.1.2 Basic switching systems used by the STDN are generally crossbar switching, T-bar relay, or Cunningham matrix.

3.5.1.3 In addition to the automated switching provided by the crossbar or matrix systems, programmable patch boards and patchpanels provide signal routing to required equipment.

3.5.1.4 Certain equipment types have provisions for remote control of switching matrixes at remote consoles such as the Data System Control Console (DSCC). Other equipment types must be switched manually at their physical location.

3.5.2 DHESS

3.5.2.1 The Data Handling Equipment Switching System (DHESS) interfaces the inputs and outputs of the PCM bit synchronizers and various other patchpanels to the link programmable patch boards. Any of four data groups from up to three link patch boards can be connected by the DHESS to the data processing equipment. The DHESS is a 10 by 10 crossbar matrix which switches 12 coaxial lines at a time, in addition to lamp and control voltages. One and two link sites have four switchable data groups per link; while three link sites have three switchable and one manually patched data group per link.

3.5.2.2 The DHESS consists of the following equipment:

a. Six 10 by 10 by 6 crossbar drawers. The first four switch three coaxial lines each, and the other two switch six lines each of control and status voltages.

b. A central control panel from which the operator can switch various decoms or patchpanels to the link project boards. (Refer to table 3-33 for controls, indicators, and settings.)

c. A signal connector panel, through which the crossbar inputs and outputs connect to the equipment.

d. A control connector panel through which the matrices are connected to the central control panel.

3.5.3 BIT SYNC AND PSK SWITCHING SYSTEMS

The bit sync and the PSK switching systems are used at stations that do not have DHE switching systems. The bit sync switching system interfaces six levels from the link patchpanels to the PCM decom bit syncs. The PSK switching system interfaces three levels from the PSK demods to the link patchpanels. The major difference between these two systems and the DHESS is the switching

NOTES

1. DATA HANDLING, RECEIVER, RECORDER AND RECORDER MONITOR SWITCHING SYSTEMS ARE CROSSBAR TYPE.

2. SWITCHING OF SELECTED PARAMETERS ON LINK PROJECT BOARD ARE PERFORMED BY THE DATA HANDLING EQUIPMENT SWITCHING SYSTEM.

3. 1 AND 2 LINK SITES HAVE 4 SWITCHABLE DG'S PER LINK. 3 LINK SITES HAVE 3 SWITCHABLE AND 1 MANUALLY PATCHED DG'S PER LINK.

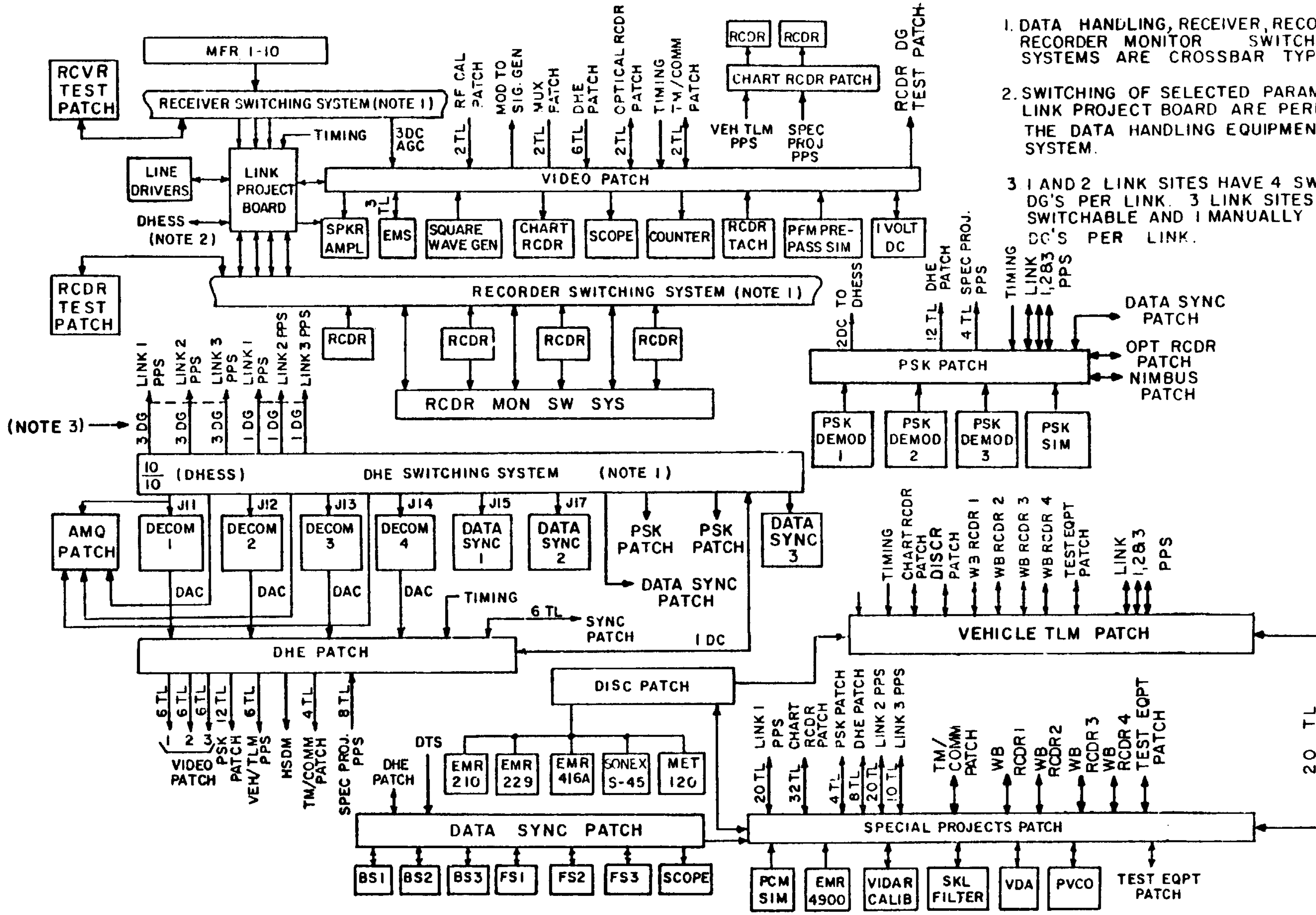


Figure 3-16. Typical STDN Crossbar Switching System

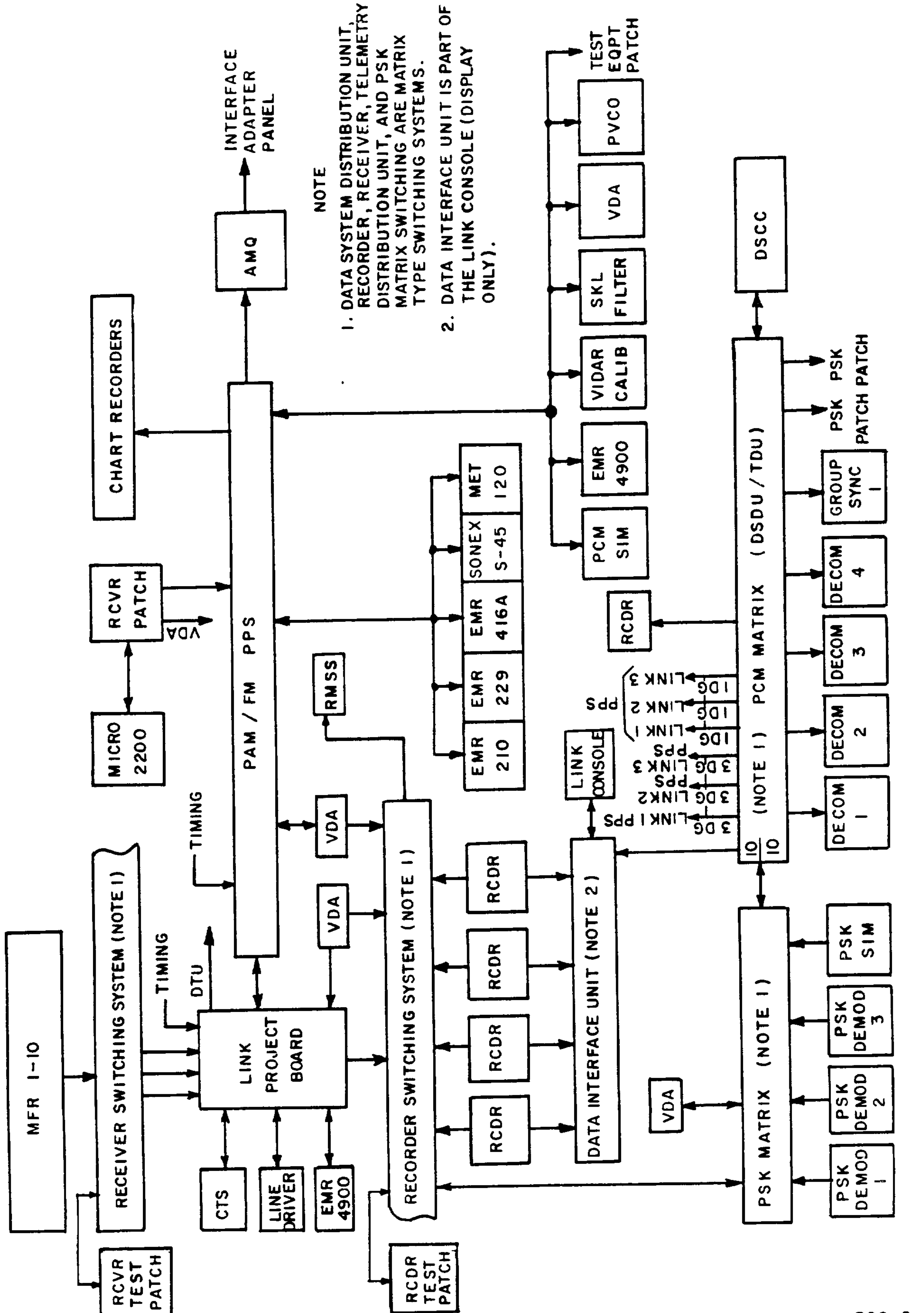


Figure 3-17. Typical Matrix Switching System

Table 3-33. DHESS Central Control Panel Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
RESET switch	Momentary	Resets selected crossbar by breaking previously selected hold coil connection.
SBY indicator (yellow)		Normally lit to indicate that associated DHE has not been selected.
BSY indicator (red)		When lit, indicates that associated DHE has been selected.
SELECT switch	In Out	Selects crossbar crosspoint which connects DHE to T/M position.
AVL indicator (yellow)		Normally lit to indicate DHE is available for selection. Goes off when crossbar crosspoint is made upon selection.
SEL indicator (green)		When lit, indicates DHE has been selected.

matrix. The bit sync system uses two Cunningham 1015B matrices, while the PSK system uses one Cunningham 1015B. The Cunningham 1015B is further described in paragraph 3.5.9.

3.5.4 RECEIVER SWITCHING SYSTEM

3.5.4.1 The receiver switching system establishes connections between the outputs of the desired receiver and the link project board. It also interfaces to the receiver switching system test patch.

3.5.4.2 The receiver switching system consists of the following equipment:

a. A central crossbar switch matrix to make the data circuits and status lamp connections.

b. A central control panel located in the receiver area, made up of receiver status panels which indicate whether each receiver is available or has been selected, and receiver select panels which select and release signal paths between the link project board. Status lamps in the select panel indicate which receiver is connected to that data group. Refer to table 3-34.

3.5.5 RECORDER SWITCHING SYSTEM

3.5.5.1 The recorder switching system is identical to the receiver switching system, and interfaces the link project board to the tape recorders. It also interfaces to the recorder switching system test patch.

3.5.5.2 The recorder switching system consists of the following equipment:

a. A central crossbar switch to make the data circuits and status lamp connections.

b. A central control panel located in the recorder areas. The status panels indicate whether each recorder is available or has been selected. The select panels select and release the data group to recorder signal paths, and indicate which recorder has been selected to that data group. Refer to table 3-35.

3.5.6 RECORDER MONITOR SWITCHING SYSTEM

3.5.6.1 The Recorder Monitor Switching System (RMSS) is used to monitor the recorder outputs from any area of the station having one of the ten RMSS control panels. The RMSS is a 10 by 10 crossbar switching system, and is identical in operation to both the receiver and recorder switching systems, with the exception that any one recorder can be monitored at one or more positions simultaneously.

3.5.6.2 The RMSS consists of the following equipment:

a. A central crossbar switch matrix which makes the data circuits and status lamp connections.

b. Ten control/status panels located at various monitoring positions. Status lamps are provided to indicate that a recorder has been selected

Table 3-34. Receiver Switching System Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
RESET PBI (one per link data group)	Momentary	Enabled with power turn-on. When pressed, resets (disconnects) associated receiver from a data group. Lights when a receiver is selected; is extinguished when the data path is deselected.
SELECT PBI (one for each receiver in the link data group)	In Out	Enabled with power turn-on. When pressed, connects associated receiver to associated data group. Green SEL indicator lights to indicate receiver is connected to data group, and is extinguished when the data channel is reset.
STATUS/AVL/BSY indicator		A split-legend indicator showing the status of the associated receiver. AVL (yellow) lights when the receiver is free; BSY (red) lights when the receiver is selected.

Table 3-35. Recorder Switching System Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
RESET PBI (one per link data group)	Momentary	Enabled with power turn-on. When pressed, resets (disconnects) associated recorder from a data group. Lights when a recorder is selected; is extinguished when the data path is deselected.
SELECT PBI (one for each recorder in the link data group)	In Out	Enabled with power turn-on. When pressed, connects associated recorder to associated data group. Green SEL indicator lights to indicate recorder is connected to data group, and is extinguished when the data channel is reset.
STATUS/AVL/BSY indicator		A split-legend indicator showing the status of the associated recorder. AVL (yellow) lights when the recorder is free; BSY (red) lights when the recorder is selected.

by the recorder switching system, and whether it has been selected by the RMSS. Only one recorder can be selected by a given control panel at any one time, and a previously selected recorder must be reset before a new one can be selected. Refer to table 3-36.

3.5.7 COMMAND SWITCHING SYSTEM

3.5.7.1 The Command Switching System (CSS) is used in the uplink telemetry section to interface encoders and transmitters. The basic switching unit is a 5 by 5 relay matrix; by using two matrices, a 5 by 5 CSS allows any of five encoders to be connected to any of five transmitters over any of five data channels. Depending upon the station, the following four CSS configurations are available:

a. 5 by 5.

b. 10 by 5, which uses three matrices and interfaces 10 encoders to 5 transmitters over 5 data channels.

c. 10 by 10, which uses four matrices to interface 10 encoders to 10 transmitters over 5 data channels.

d. 3 by 3, which uses one modified 5 by 5 matrix.

3.5.7.2 The CSS is contained in one rack and consists of the following equipment from top to bottom (refer to table 3-37):

a. Up to three 5 by 5 matrices. The first and second are encoder 1-5 and transmitter 1-5, respectively. The third is encoder 6-10 (if used).

b. For the CSS control chassis, there are four versions of the control panel, one for each CSS configuration (refer to paragraph 3.5.7.1).

c. Transmitter 6-10.

3.5.8 COMMAND ENCODER VERIFICATION SWITCHING SYSTEM

3.5.8.1 The Command Encoder Verification Switching System (CEVSS) is used to interface any of five encoders to any of five decommutators. When a spacecraft receives a command from the encoder, it stores the command in a buffer, and transmits the contents of the buffer. The received command is decommutated and sent back to the encoder for verification and subsequent execute command. The CEVSS is separate from the CSS, but its function is best understood by considering it to be a part of the command loop (CSS is uplink, CEVSS is downlink). The CEVSS uses one 5 by 5 relay matrix of the same type used IN the CSS.

3.5.8.2 The CEVSS consists of the following equipment:

a. A 5 by 5 relay switching matrix which makes the data circuit and status/indicator connections.

b. A CEVSS control panel from which the operator selects the data path from the proper decommutator to the uplink encoder for command verification. Refer to table 3-38.

Table 3-36. RMSS Control and Indicator Description

Name	Type	Function
Reset/PWR/BSY	PBI	Reset pushbutton releases corresponding hold actuator. PWR indicator indicates that the control/status chassis is connected to the crossbar rack. BSY indicator indicates that the corresponding hold actuator is energized. Reset switch must be pressed prior to making another selection.
Select/ON LINE/SEL	PBI	Select pushbutton selects desired recorder to be monitored by energizing corresponding hold and select actuators. ON LINE indicator indicates that the corresponding subsystem has been selected by the recorder switching system. SEL indicator indicates that the corresponding recorder system has been selected for monitoring by a control/status chassis.

Table 3-37. CSS Control Panel Controls, Indicators, and Nominal Settings

Control	Position	Purpose
RESET switch	Momentary	Resets selected crosspoint relay, disconnecting the data channel and the encoder or the transmitter. The control panel is divided in half to separate the encoders and transmitters in the other section. There are two sections of controls and indicators.
ON-LINE indicator	White	Lights to indicate that a data channel has been selected. The lamp is extinguished when the relay has been reset.
CHANNEL SELECT switch	Momentary	Selects a data channel and equipment (either an encoder or a transmitter).
SELECT indicator	Green	Lights when a crosspoint relay in a data channel column of the matrix has been energized. Extinguishes when the data channel is reset.
ENCODER/TRANSMITTER SELECT switch	Momentary	Selects equipment and data channel. The appropriate SELECT switch and channel switch must be pressed simultaneously to energize a cross-point relay and establish the connection.
AVL indicator	Yellow	Lights when equipment is not selected to a data channel.
BSY indicator	Red	Lights when equipment is selected to a data channel. To verify data channel selection, push the desired CHANNEL SELECT switch. The appropriate ENCODER SELECT switch lights AVL and BSY simultaneously.
CONTROL switch	Momentary	Switches control of channel selection from the control panel to a computer. This portion of the system is not implemented; therefore, the CONTROL switch should always be in the local mode.
COMPUTER/LOCAL indicators		CONTROL should always be in local mode. LOCAL lamp should always be lit.

Table 3-38. CEVSS Control Panel Controls, Indicators, and Nominal Settings

Control	Position	Purpose
ENCODER SELECT switch	Momentary	When pressed simultaneously with a DHE (decom) switch, energizes a crosspoint relay for a DHE/encoder data path.
ENCODER indicator		Lights when a crosspoint in the encoder matrix column is selected.
DHE SELECT switch	Momentary	Combined with an encoder selection, selects a matrix crosspoint.
DHE indicator		Lights when a crosspoint interfacing the DHE is selected.
RESET switch	Momentary	Each ENCODER SELECT switch has a RESET switch. Pressing RESET 2 releases the data channel between encoder 2 and the appropriate DHE.
RESET indicator		Always lit.
MODE switch	Momentary	Establishes control of the matrix in either local (manual) or computer mode. This feature was never implemented. Therefore, the control panel should always be in local mode.
LOCAL/COMPUTER indicator		LOCAL should always be lit.

3.5.9 CUNNINGHAM MATRIX SWITCHING SYSTEM

3.5.9.1 The Cunningham matrix switching system is a versatile and flexible matrix switching assembly capable of accommodating a wide variety of input signals. The switching system can be activated either locally at the particular system, or remotely. The switching system uses saturable core, magnetically latched reed crosspoint relays which retain a preprogrammed configuration in the event of a loss of primary power. The switching matrix is composed of three individual 15 by 14 switching matrixes which are expandable to either a single 45 by 14 matrix, or a 15 by 14 and a 30 by 14 matrix. The switching matrix has a front-panel display which presents a visual identification of the entire input/output configuration. The switching matrix has front-panel monitor switches which enable the operator to select any input signal for monitoring. The switching matrix frequency response is to 20 MHz with 50-dB crosstalk isolation. Table 3-39 lists the front-panel control functions.

3.5.9.2 The Model 1016 remote control panel, which may be used at some stations, has capabilities identical to the local panel on the matrix switch assembly. Front-panel controls are detailed in table 3-40.

3.5.10 PREPROGRAMMABLE PATCH SYSTEM

This system establishes the portion of telemetry signal routing that varies as a function of spacecraft project requirements. The system consists of a project board panel for each RF link, into which prepatched project boards can be plugged. Each station has one or more prepatched project boards for each satellite. Prior to the mission, the applicable project board is inserted into the project board panel of the RF link to be used. Typical positions for the various signals on the board are shown in figures 3-18 and 3-19. Some of the patches make telemetry data connections, while others light indicators on the project board panel and various other panels to indicate what equipment is required for the mission.

3.5.11 TELEMETRY DATA SYSTEMS CONTROL CONSOLE

The Data Systems Control Console (DSCC) provides a means of centrally controlling all operations of the STDN station telemetry system, and is intended to provide the capability for fast changing of signal routing configurations and controlling systems operation for manned and scientific missions. The following functions are included:

a. Control of the telemetry matrix switching systems.

b. Monitor capability of all telemetry data remoted to GSFC.

c. Operations control of all wideband instrumentation recorders, PCM decoms, and simulators.

d. Monitoring capability for all recorded and PCM input/output data.

e. Tape search control of magnetic tape recorders.

f. BCD-to-binary converter for tape playback, and binary time to 642B computer.

g. Binary buffer for interface from binary converter to PDP-11 computer.

Table 3-39. Model 1015B Front-panel Controls, Indicators, and Nominal Switch Settings

Control/Indicator	Position	Purpose
15 x 14 No. 1 Control		
REMOTE/LOCAL PBI	REMOTE	Selects control of the matrix to the remote control unit.
	LOCAL	Selects control of the matrix to the matrix.
LAMP TEST switches	X0-X6	Tests indicator rows X1 through X7 on the display section as the associated switch is rotated from 1 through 7.
	X7-X TEST	Tests indicator rows X8 through XT on the display section as the associated switch is rotated from 1 through 7.
LAMP TEST selector	OFF 1 through 8	Turns test off. In active position it activates the appropriate row of matrix indicators in conjunction with LAMP TEST switch.
INPUT SELECT (Y)	1 through 15	Used in conjunction with OUTPUT SELECT (X) switches to select a signal coordinate.
OUTPUT SELECT (X)	1 through 14	Used in conjunction with INPUT SELECT switches to select a signal coordinate.
X TEST SELECT switch		Used to connect output signal coordinate to a front-panel BNC connector for monitor purposes.
NORMAL/DISABLE switch/indicator	ON OFF	When on, activates the disconnect switches causing the output from the matrixes to be disconnected from the output on the rear panel and extinguishes NORMAL indicator. When set to NORMAL, outputs are available at the rear panel, and the DISABLE indicator is extinguished.

Table 3-39. Model 1015B Front-panel Controls, Indicators, and Nominal Switch Settings (cont)

Control/Indicator	Position	Purpose
OPERATE/RELEASE switch/indicator (interlocking)	OPERATE	In this position, the matrix push-buttons cause a crosspoint to be closed.
	RELEASE	In this position, the matrix pushbuttons cause a crosspoint to be opened.
AUTO PROGRAM selector switch	OFF	Inhibits the program boards.
	1	Allows selection of preprogrammed signal patching and crosspoints on program board No. 1.
	2	Allows selection of preprogrammed signal patching and crosspoints on program board No. 2.
	3	Allows selection of preprogrammed signal patching and crosspoints on program board No. 3.

Table 3-40. Model 1016 Remote Control Unit Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
15 by 14 No. 2 and 3 Control		
Identical to No. 1		
Matrix Selector Switching System		
OPERATE PBI	ON OFF	Applies power to the selector system and indicates when power is on.
STATION PBI's (interlocking)	1	Places the matrix remote control unit in control of No. 1 Cunningham matrix.
	2	Places the matrix remote control unit in control of No. 2 Cunningham matrix.
	3	Places the matrix remote control unit in control of No. 3 Cunningham matrix.
	4	Places the matrix remote control unit in control of No. 4 Cunningham matrix.
	5	Places the matrix remote control unit in control of No. 5 Cunningham matrix.
	6	Places the matrix remote control unit in control of No. 6 Cunningham matrix.
	7	Places the matrix remote control unit in control of No. 7 Cunningham matrix.
	8	Places the matrix remote control unit in control of No. 8 Cunningham matrix.

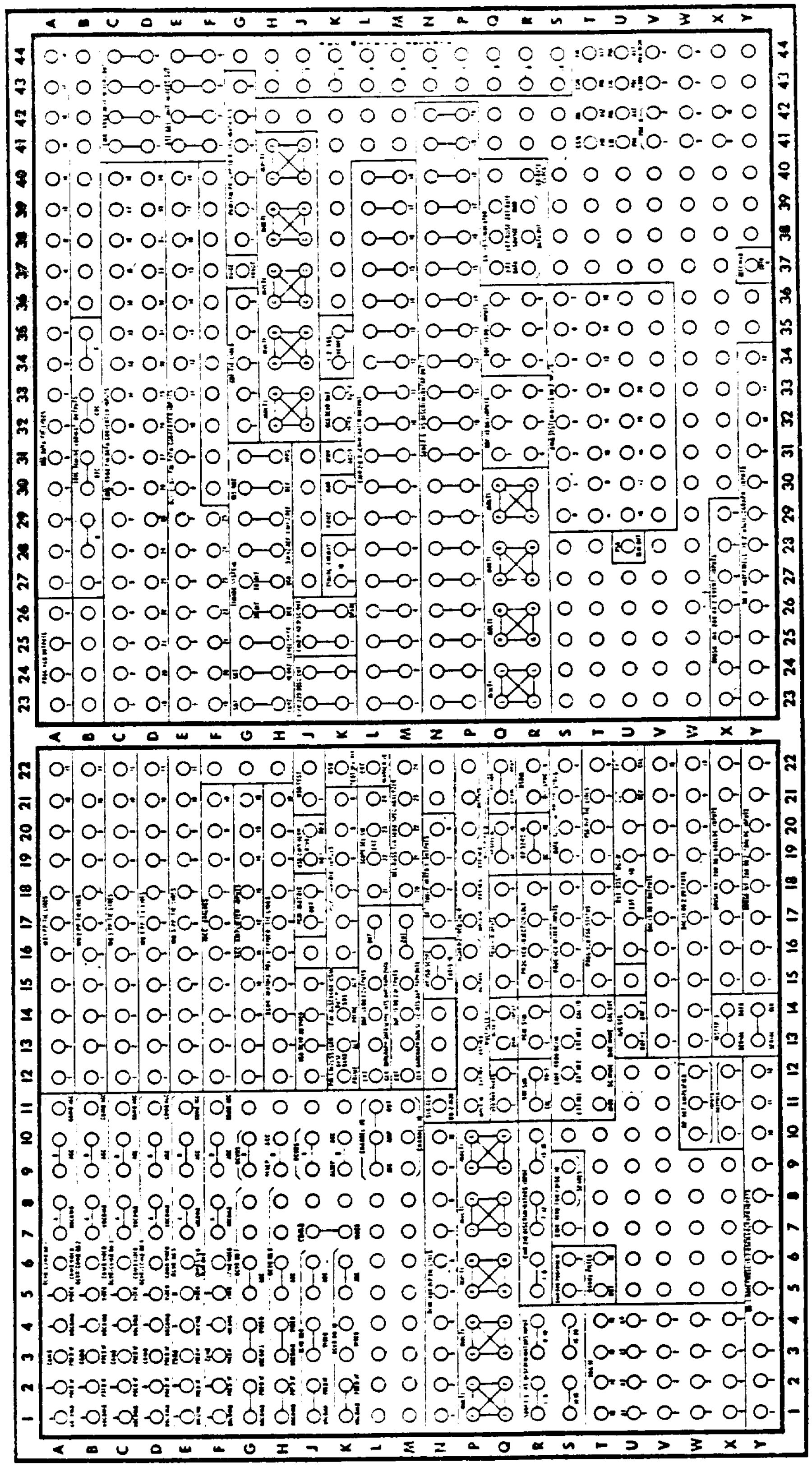


Figure 3-18. VHF/FM/PAM Programmable Patchpanel

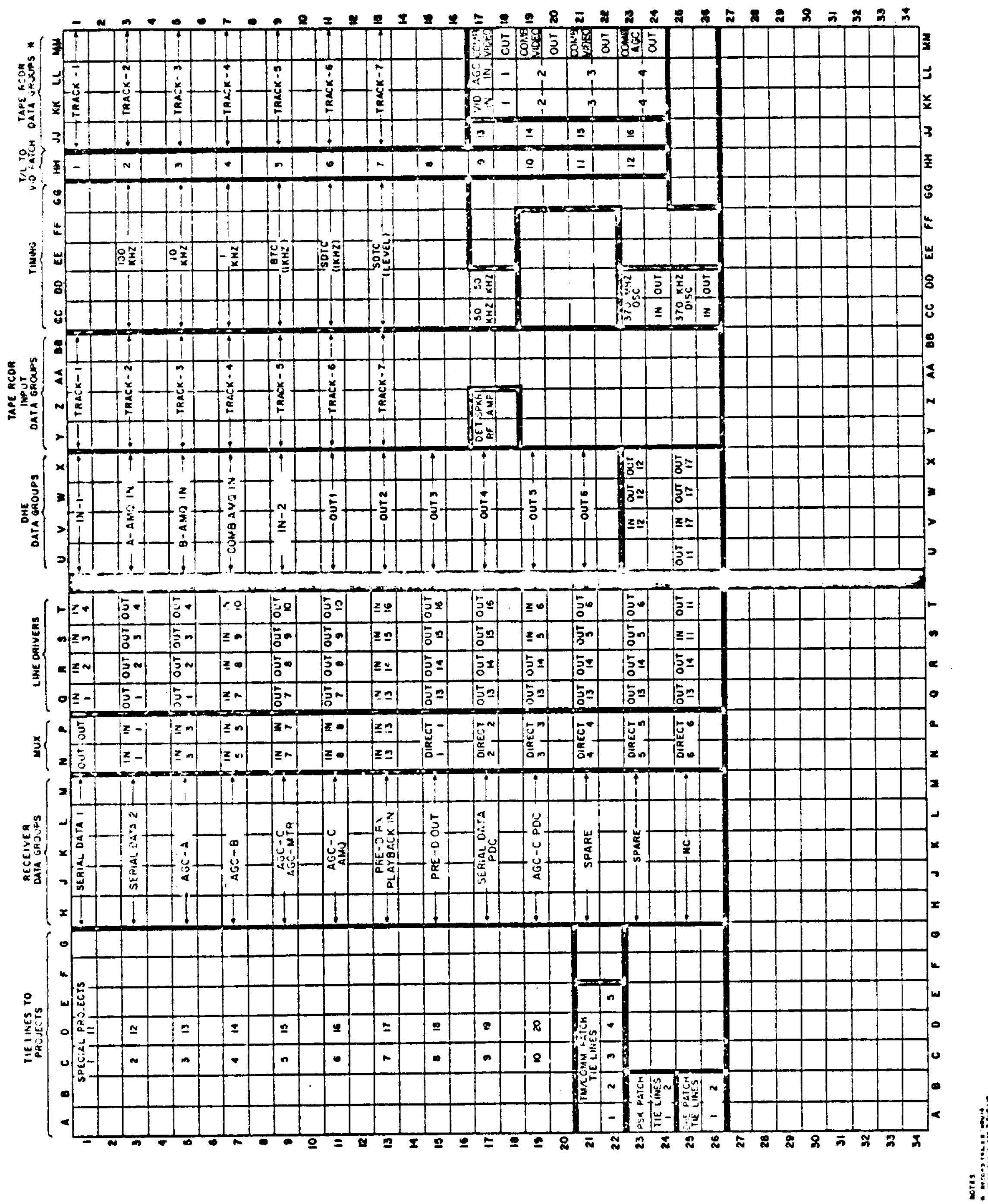


Figure 3-19. Link Programmable Project Board

	RCVR DATA GROUPS 1 A	2 B	3 C	4 D	5 E	PDC F	G	EMR 4900 MUX H	J	LINE DRIVERS K	L	M	N	P	BIT SYNC/PSK DATA GROUPS Q	R	S	T	RECORDERS DATA GROUPS 1 U	2 V	3 W	4 X
1	SER DATA 1 OUT					VIDEO 1 IN		MIX 1 OUT	MIX 2 OUT	LD 1 IN	LD 2 IN	LD 3 IN	LD 4 IN	LD 5 IN	BIT SYNC SW SOURCE 1 IN				RCD	TK	1	IN
2	SER DATA 2 OUT					2 IN		CHAN 1 IN	CHAN 10 IN	1 OUT	2 OUT	3 OUT	4 OUT	5 OUT	BIT SYNC SW NRZ-L OUT				RCD	TK	2	IN
3	AGC A OUT					3 IN		2 IN	11 IN	1 OUT	2 OUT	3 OUT	4 OUT	5 OUT	BIT SYNC SW BIφ OUT				RCD	TK	3	IN
4	AGC B OUT					4 IN		3 IN	12 IN	LD 6 IN	LD 7 IN	LD 8 IN	LD 9 IN	LD 10 IN	AMQ AGC A/B INPUTS				RCD	TK	4	IN
5	AGC C OUT					AGC 1 IN		4 IN	13 IN	6 OUT	7 OUT	8 OUT	9 OUT	10 OUT	AMQ AGC C INPUTS				RCD	TK	5	IN
6	AGC C OUT					2 IN		5 IN	14 IN	6 OUT	7 OUT	8 OUT	9 OUT	10 OUT	AMQ RCVR LOCK STATUS IN				RCD	TK	6	IN
7	PRE-D PLAY BACK IN				IN	3 IN		6 IN	15 IN	LD 11 IN	X	LD 12 IN	12 OUT	LD 13 IN	PSK DEMOD SOURCE 1 IN				RCD	TK	7	IN
8	PRE D OUT					4 IN		7 IN	16 IN	11 OUT	11 OUT	12 IN	12 OUT	LD 13 IN	PSK DEMOD OUTPUTS				REPRO	TK	1	OUT
9	SER. DATA 3 OUT					VIDEO 1 OUT		8 IN	17 IN	11 OUT	11 OUT	12 OUT	12 OUT	13 OUT	PSK DEMOD LOCK STATUS				REPRO	TK	2	OUT
10	AGC C OUT					2 OUT		9 IN	18 IN	LD 14 IN		X	12 OUT	13 OUT					REPRO	TK	3	OUT
11	RCVR LOCK STATUS OUT					3 OUT		EXT IN		14 OUT	14 OUT	14 OUT	X	13 OUT					REPRO	TK	4	OUT
12	←SPARE→					AGC OUT				14 OUT	14 OUT	14 OUT	13 OUT	13 OUT	DATA SYNC P/P TLI		SHUTTLE CMD VERIF OUT		REPRO	TK	5	OUT
13	PAM / TLI	FM P/P 11	DCS 200 KH IF			TMI/COMM P/P TLI	OHE P/P TLI	PSK P/P TLI	DISC P/P TLI						2		CMD VERF OUT		REPRO	TK	6	OUT
14	2	12				2	2	2	2						3			VOICE ANNO	REPRO	TK	7	OUT
15	3	13				3	3	3	3						4				CONSTANT AMPLITUDE REFERENCE OUT			
16	4	14				4	4	4	4						5	VIDEO P/P TIE LINES 1	2	3	←100 KHZ→			
17	5	15				5	5	5	5						6	4	5	6	←10 KHZ→			
18	6	16													7	7	8	9	←1 KHZ→			
19	7	17													8	10	11	12	←BTC ON 1 KHZ→			
20	8	18													9	13	14	15	←→			SDTC 1 KHZ
21	9	19													10	16			←→			SDTC LEVEL
22	10	20													DATA SYNC P/P TLI II				BTC 50 KHZ	12.5 KHZ		
23	AMQ P/P TIE LINES 1	2	3	4	5																	

Figure 3-20. Programmable Board Assembly

3.5.12 REMOTE HIGH-SPEED DATA MONITOR (MONITOR 400)

The high-speed data monitor provides a means of monitoring 7.2-kb/sec remoted data. The high-speed data monitor displays up to three data words at any instant. To display a word, the high-speed data monitor requires a knowledge of the word, format ID, and frame location. A signal conditioner is included to process the incoming bit rates. An additional function of the Monitor 400 decommutator is to monitor telemetry burst data. Table 3-41 lists equipment characteristics and table 3-42 lists Monitor 400 front-panel controls and nominal settings.

Table 3-41. Monitor 400 PCM Decommutator Characteristics

Parameter	Characteristics
<u>Bit Synchronizer</u>	
Input code	NRZ-S, NRZ-M, NRL-L.
Bit rate	100 to 10,000 bits/sec.
Output code	NRZ-L.
Output level	0 and +5 V.
<u>Decommutator</u>	
Bit rate	7.2 kb/sec.
Word length	Up to 10 bits.
Frame length	Up to 1000 words/frame.
Supercommutation	Capable of displaying a supercommutated data word whose rate is from 2 to 32 adjacent mainframe samples, or 2 to 32 samples spaced 1 to 15 words apart.
<u>Computer Interface</u>	
Logic level	Slow interface: 0 V: logical 1; -15 V: logical 0.

Table 3-42. Monitor 400 PCM Decommutator Front-panel Controls and Nominal Settings.

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Turns on unit.
BIT SYNC SOURCE switch	1 2 3 4 5	Selects 1 of 5 input connectors.
NRZ switch	L M S	Selects incoming PCM code.
LOOP BW switch	WIDE NAR	Selects signal conditioner loop width.
DECOM SOURCE switch	1 2 3 4 BIT SYNC	Selects decom input from signal conditioner or one of four input connectors.
NORM/INVT switch	NORM INVT	Sets incoming PCM polarity.
RESET switch	Momentary	Resets applicable synchronizer.
LINE FORMAT ID switch	A B	Selects line format display.
COMPUTER switch	ON OFF	Inhibits data to computer.
DISPLAY (3 switches)	MF SF	Selects mainframe or subframe data for display.
WORD (3 switches)	Variable 000-999	Selects word for display.
FRAME (3 switches)	Variable 00-99	Selects frame for display.
ID (3 switches)	A B	Selects interleaf for display.

3.5.13 PCM DECOM REMOTE-CONTROL PANEL

The PCM decom remote-control panel provides a means of operating and monitoring four PCM decoms from the DSCC. Table 3-43 lists the PCM decom remote-control panel function.

3.5.14 BINARY/DECIMAL DISPLAY UNIT

The binary/decimal display unit provides a convenient means of selecting and monitoring spacecraft parameters in PCM data. The control functions of the binary/decimal display unit are listed in table 3-44.

Table 3-43. PCM Decom Remote-control Panel Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
PCM Decom No. 1		
REMOTE ENABLE indicator		Indicates PCM decom is under control of the remote-control panel.
COMPUTER LOAD indicators	ENABLE	Indicates the computer can load the PCM decom program.
VEHICLE ID indicator		Indicates for which vehicle the PCM decom is formatted to process data.
FORMAT SELECT switch	0-9	Used to select the PCM decom format.
FORMAT RESET switch	Momentary	Resets the PCM decom format.
FORMAT CHANGE switch	Momentary	When pressed, changes the PCM format to that selected by the FORMAT SELECT switch.
DECOM INPUT SELECT switch	NB (Narrow-band) WB (Wide-band) SP (Stored Program) MAN (Manual)	Selects type of signal to be input to the PCM decom.
SYNCHRONIZER STATUS indicators	FRAME	Indicates decom has mainframe sync.
	SF 1	Indicates decom has subframe No. 1 sync.
	SF 2	Indicates decom has subframe No. 2 sync.
	SF 3	Indicates decom has subframe No. 3 sync.
	ID	Indicates decom has ID sync.

Table 3-43. PCM Decom Remote-control Panel Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Computer Buffer No. 1		
INHIBIT switch	ON OFF	Used to inhibit PCM data to the computer buffer.
INHIBIT indicator		Indicates PCM data is inhibited.
PLAYBACK BIT switch	ON OFF	Used to set the playback bit when signal input to the decom is recorded data.
PLAYBACK BIT indicator		Indicates the playback bit in the PCM bit stream has been set going to the computer buffer.
NIA indicator		Indicates computer does not acknowledge the PCM data input.
Computer Buffer No. 2		
Identical to Computer Buffer No. 1		
INHIBIT switch	ON OFF	Used to inhibit PCM data to computer buffer.
INHIBIT indicator		Indicates PCM data is inhibited.
PCM Decom No. 2, No. 3, and No. 4		
Identical to PCM decom No. 1		

Table 3-44. Binary/Decimal Display Unit Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	On Off	Used to apply power to the unit.
AC indicator		Indicates power is on.
PCM SELECT switch	1-6	Selects PCM decom for input to the unit.
WORD LENGTH switch	1-10	Selects length of word to be converted and displayed.
CHANNEL SELECT switches	0000 - 7777	Selects the PCM address of the word.
BINARY DISPLAY indicator	Bits 1-32 with bit 1 the MSB	Displays the binary value of the selected word.
DECIMAL DISPLAY indicator	0000 - 9999	Displays the decimal value of the selected word.
ANALOG DISPLAY meter	0 - 100%	Displays the analog value of the selected word in percent of full scale.
LAMP TEST switch	Momentary	Used to check all indicators simultaneously.
RESET switch	Momentary	Used to reset the converter for an updated readout of the selected word.

3.5.15 TCT GENERATOR INPUT/OUTPUT PATCHPANEL

This patchpanel is used to route signals into and out of the Time Code Translator Generator (TCTG) from the recorders.

3.5.16 DATATRON MODEL 3000 TCTG

The TCTG provides automatic search and playback capabilities for the magnetic tape recorders. It also converts either the serial 36-bit NASA time code or serial decimal time code to a 42-bit parallel binary-coded decimal which is output to the BCD-to-binary converter. During magnetic tape playback, the system can supply the BCD-to-binary converter with tape GMT.

3.5.17 DATATRON 3600 DC CODE/FAIL-SAFE UNIT

The DC code/fail-safe unit interfaces the magnetic tape recorder timing source to the TCTG.

3.5.18 DATATRON MODEL 3800 TAPE TRANSPORT SWITCHING UNIT

The tape transport switching unit interfaces the tape search unit to the magnetic tape transport unit. The desired transport is switch-selectable on the front panel of the unit.

3.5.19 DATATRON MODEL 3400 TAPE SEARCH UNIT

The tape search unit is used in conjunction with the TCTG to automatically locate a specific GMT on the magnetic tape. The search time is selected on the tape search unit by means of thumbwheel switches. The capability exists to select both start and stop times. The tape search unit searches the tape for the start time selected and then plays until the selected stop time. This stops the tape transport and recycles it back to the start time and repeats the cycle continuously until the cycle is manually interrupted.

3.5.20 CTE/MET CLOCK CONTROL SWITCHING AND CONNECTOR PANEL

This panel is used to route CTE/MET timing signals from the PCM decoms to the CTE/MET displays in the DSCC.

3.5.21 CTE/MET DISPLAYS

These displays are mounted in the DSCC to monitor received CTE and MET time.

3.5.22 GMT AND GET DISPLAYS

These displays are used to monitor station time and mission time.

3.5.23 P/N 801114-1 BCD-TO-BINARY CONVERTER

The BCD-to-binary converter converts standard 42-bit parallel BCD Time-of-year (TOY) codes into binary format for computer interface. The binary output consists of two parallel words, one 9-bit word for day of year, and one 27-bit word for time of day (in milliseconds). Output monitoring is also provided through front-panel visual displays.

3.5.24 DATATRON MODEL 3700 SERIAL REMOTE DISPLAY

The serial remote display unit decodes IRIG A, IRIG B, or NASA 36-bit BCD serial time code formats. The decoded time is available in several forms for use by other equipment, and is displayed on a front-panel readout. Table 3-45 lists the rear-panel remote display controls.

Table 3-45. Model 3700 Serial Remote Display Controls (Rear Panel)

Control	Position	Purpose
AC POWER	ON/OFF	Applies ac power to unit.
FILTER	OFF/1 KHZ/ 10 KHZ	Provides selectable carrier-frequency filtering.
CODE	IRIG A/IRIG B/ NASA 36	Programs the translator to decode the selected format.
FRAME	0/1/2/4	Allows the unit to bypass the selected number of frames before the accumulators are updated.

3.5.25 SYSTRON DONNER MODEL 8155-0412 SYNCHRONIZER TIME CODE GENERATOR

The synchronized time code generator operates as an independent generator from its own internal time base, or in synchronization with the serial 36-bit NASA time code. The unit outputs three separately-buffered parallel outputs for other equipment, and is displayed on a front-panel readout. Table 3-46 lists the time code generator controls.

Table 3-46. Systron Donner Model 8155-0412 Synchronizer Time Code Generator Controls

Control	Position	Purpose
	Front-panel	
1 MHZ CLEAR	Momentary action as required	Clears 1 MHz reference dropout detector.
PRESET/ RESET	Momentary action as required	PRESET loads contents of the time-set thumbwheel switches into the accumulator. RESET clears the accumulator.
MODE SELECTOR		
	PWR OFF	Removes power from unit.
	STOP	ARMS PRESET/RESET switch stops time base counter.
	HOLD	ARMS PRESET/RESET switch stops the count in the accumulator.
	GEN	Updates the accumulator from the internal time base.
	SYNC	Synchronizes the unit with the input time code 1-MHz and 1 p/sec reference signals.
PROPAGATION DELAY MS	As required	Enters preset start delays (001 to 999 sec) when operating in the sync mode.
TIME SET	As required	Nine-digit thumbwheel switch register used to enter preset start time (in days through seconds) in generate mode.
	Rear-panel	
LP-YR	As required	Selects 365-or 366-day recycle.

3.5.26 EVENT STATUS PANEL

This panel provides a display of equipment operating events and status.

3.5.27 VOICE MONITOR AND INTERCOM PANELS

These panels are used for station communication from one equipment station to another as well as for communication from the station to GSFC.

3.5.9 PCM DECOM REMOTE-CONTROL PANEL

The PCM decom remote-control panel provides a means of operating and monitoring four PCM decoms from the DSCC. Table 3-47 lists the PCM decom remote-control panel functions.

3.5.10 BINARY/DECIMAL DISPLAY UNIT

The binary/decimal display unit provides a convenient means of selecting and monitoring spacecraft parameters in the PCM data. The control functions of the binary/decimal display unit are listed in table 3-48.

Table 3-47. PCM Decom Remote-control Panel Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
PCM Decom No. 1		
REMOTE ENABLE indicator		Indicates PCM decom is under control of the remote control panel.
COMPUTER LOAD indicators	ENABLE	Indicates the computer can load the PCM decom program.
VEHICLE ID indicator		Indicates for which vehicle the PCM decom is formatted to process data.
FORMAT SELECT switch	0-9	Used to select the PCM decom format.
FORMAT RESET switch	Momentary	Resets the PCM decom format.
FORMAT CHANGE switch	Momentary	When pressed, changes the PCM format to that selected by the FORMAT SELECT switch.
DECOM INPUT SELECT switch	NB (Narrow-band) WB (Wide-band) SP (Stored Program) MAN(Manual)	Selects type of signal to be input to the PCM decom.
SYNCHRONIZER STATUS indicators	FRAME	Indicates decom has main frame sync.
	SF 1	Indicates decom has subframe No. 1 sync.
	SF 2	Indicates decom has subframe No. 2 sync.
	SF 3	Indicates decom has subframe No. 3 sync.
	ID	Indicates decom has ID sync.
Computer Buffer No. 1		
INHIBIT switch	ON OFF	Used to inhibit PCM data to the computer buffer.
INHIBIT indicator		Indicates PCM data is inhibited.
PLAYBACK BIT switch	ON OFF	Used to set the playback bit when signal input to the decom is recorded data.
PLAYBACK BIT indicator		Indicates the playback bit in the PCM bit stream has been set going to the computer buffer.
NIA indicator		Indicates computer does not acknowledge the PCM data input.

Table 3-47. PCM Decom Remote-control Panel Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Computer Buffer No. 2		
Identical to Computer Buffer No. 1.		
INHIBIT switch	ON OFF	Used to inhibit PCM data to computer buffer.
INHIBIT indicator		Indicates PCM data is inhibited.
PCM Decom No. 2, No. 3, and No. 4		
Identical to PCM Decom No. 1		

Table 3-48. Binary/Decimal Display Unit Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	On Off	Used to apply power to the unit.
AC indicator		Indicates power is on.
PCM SELECT switch	1-6	Selects PCM decom for input to the unit.
WORD LENGTH switch	1-10	Selects length of word to be converted and displayed.
CHANNEL SELECT switches	0000 - 7777	Selects the PCM address of the word.
BINARY DISPLAY indicator	Bits 1-32 with bit 1 the MSB	Displays the binary value of the selected word.
DECIMAL DISPLAY indicator	0000 - 9999	Displays the decimal value of the selected word.
ANALOG DISPLAY meter	0 - 100%	Displays the analog value of the selected word in percent of full scale.
LAMP TEST switch	Momentary	Used to check all indicators simultaneously.
RESET switch	Momentary	Used to reset the converter for an updated readout of the selected word.

3.5.11 TCT GENERATOR INPUT/OUTPUT PATCHPANEL

This patchpanel is used to route signals into and out of the Time Code Translator Generator (TCTG) from the recorders.

3.5.12 DATATRON MODEL 3000 TCTG

The TCTG provides automatic search and playback capabilities for the magnetic tape recorders. It also converts either the serial 36-bit NASA time code or serial decimal time code to a 42-bit parallel binary-coded decimal which is output to the BCD-to-binary converter. During magnetic tape playback, the system can supply the BCD-to-binary converter with tape GMT.

3.5.13 DATATRON 3600 DC CODE/FAIL-SAFE UNIT

The DC code/fail-safe unit interfaces the magnetic tape recorder timing source to the TCTG.

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The tape search unit is used in conjunction with the TCTG to automatically locate a specific GMT on the magnetic tape. The search time is selected on the tape search unit by means of thumbwheel switches. The capability exists to select both start and stop times. The tape search unit searches the tape for the start time selected and then plays until the selected stop time. This stops the tape transport and recycles it back to the start time and repeats the cycle continuously until the cycle is manually interrupted.

3.5.16 CTE/MET CLOCK CONTROL SWITCHING AND CONNECTOR PANEL

This panel is used to route CTE/MET timing signals from the PCM decoms to the CTE/MET displays in the DSCC.

3.5.17 CTE/MET DISPLAYS

These displays are mounted in the DSCC to monitor received CTE and MET time.

3.5.18 GMT AND GET DISPLAYS

These displays are used to monitor station time and mission time.

3.5.19 P/N 801114-1 BCD-TO-BINARY CONVERTER

The BCD-to-binary converter converts standard 42-bit parallel BCD Time-of-year (TOY) codes into binary format for computer interface. The binary output consists of two parallel words, one 9-bit word for day of year, and one 27-bit word for time of day (in milliseconds). Output monitoring is also provided through front-panel visual displays.

3.5.20 DATATRON MODEL 3700 SERIAL REMOTE DISPLAY

The serial remote display unit decodes IRIG A, IRIG B, or NASA 36-bit BCD serial time code formats. The decoded time is available in several forms for use by other equipment, and is displayed on a front-panel readout. Table 3-49 lists the rear-panel remote display controls.

Table 3-49. Model 3700 Serial Remote Display Controls (Rear Panel)

Control	Position	Purpose
AC POWER	ON/OFF	Applies ac power to unit.
FILTER	OFF/1 KHZ/ 10 KHZ	Provides selectable carrier-frequency filtering.
CODE	IRIG A/IRIG B/ NASA 36	Programs the translator to decode the selected format.
FRAME	0/1/2/4	Allows the unit to bypass the selected number of frames before the accumulators are updated.

3.5.21 SYSTRON DONNER MODEL 8155-0412 SYNCHRONIZER TIME CODE GENERATOR

The synchronized time code generator operates as an independent generator from its own internal time base, or in synchronization with the serial 36-bit NASA time code. The unit outputs three separately-buffered parallel outputs for other equipment, and is displayed on a front-panel readout. Table 3-50 lists the time code generator controls.

Table 3-50. Systron Donner Model 8155-0412 Synchronizer Time Code Generator Controls

Control	Position	Purpose
	Front-panel	
1 MHZ CLEAR	Momentary action as required	Clears 1 MHz reference dropout detector.
PRESET/ RESET	Momentary action as required	PRESET loads contents of the time-set thumbwheel switches into the accumulator. RESET clears the accumulator.
MODE SELECTOR	(As required) PWR OFF	Removes power from unit.
	STOP	ARMS PRESET/RESET switch stops time base counter.
	HOLD	ARMS PRESET/RESET switch stops the count in the accumulator.
	GEN	Updates the accumulator from the internal time base.
	SYNC	Synchronizes the unit with the input time code 1-MHz and 1 pp/sec reference signals.
PROPAGATION DELAY MS	As required	Enters preset start delays (001 to 999 μsec) when operating in the sync mode.
TIME SET	As required	Nine-digit thumbwheel switch register used to enter preset start time (in days through seconds) in generate mode.
	Rear-panel	
LP-YR	As required	Selects 365-or 366-day recycle.

3.5.22 EVENT STATUS PANEL

This panel provides a display of equipment operating events and status.

3.5.23 VOICE MONITOR AND INTERCOM PANELS

These panels are used for station communication from one equipment station to another as well as for communication from the station to GSFC.

SECTION 4. DATA HANDLING EQUIPMENT

SECTION 4. DATA HANDLING EQUIPMENT

4.1 GENERAL

4.1.1 Data Handling Equipment (DHE) is primarily used for converting incoming data from its spacecraft-encoded form into the form in which it existed before encoding. It may also be used for intersite data flow within the network. Signals used for these purposes are pulse modulated in code form. Codes used may include Pulse Code Modulation (PCM), Pulse Amplitude Modulation (PAM), Pulse Duration Modulation (PDM), Pulse Frequency Modulation (PFM) or, on occasion, a combination of these. Figure 4-1 illustrates a typical data handling configuration.

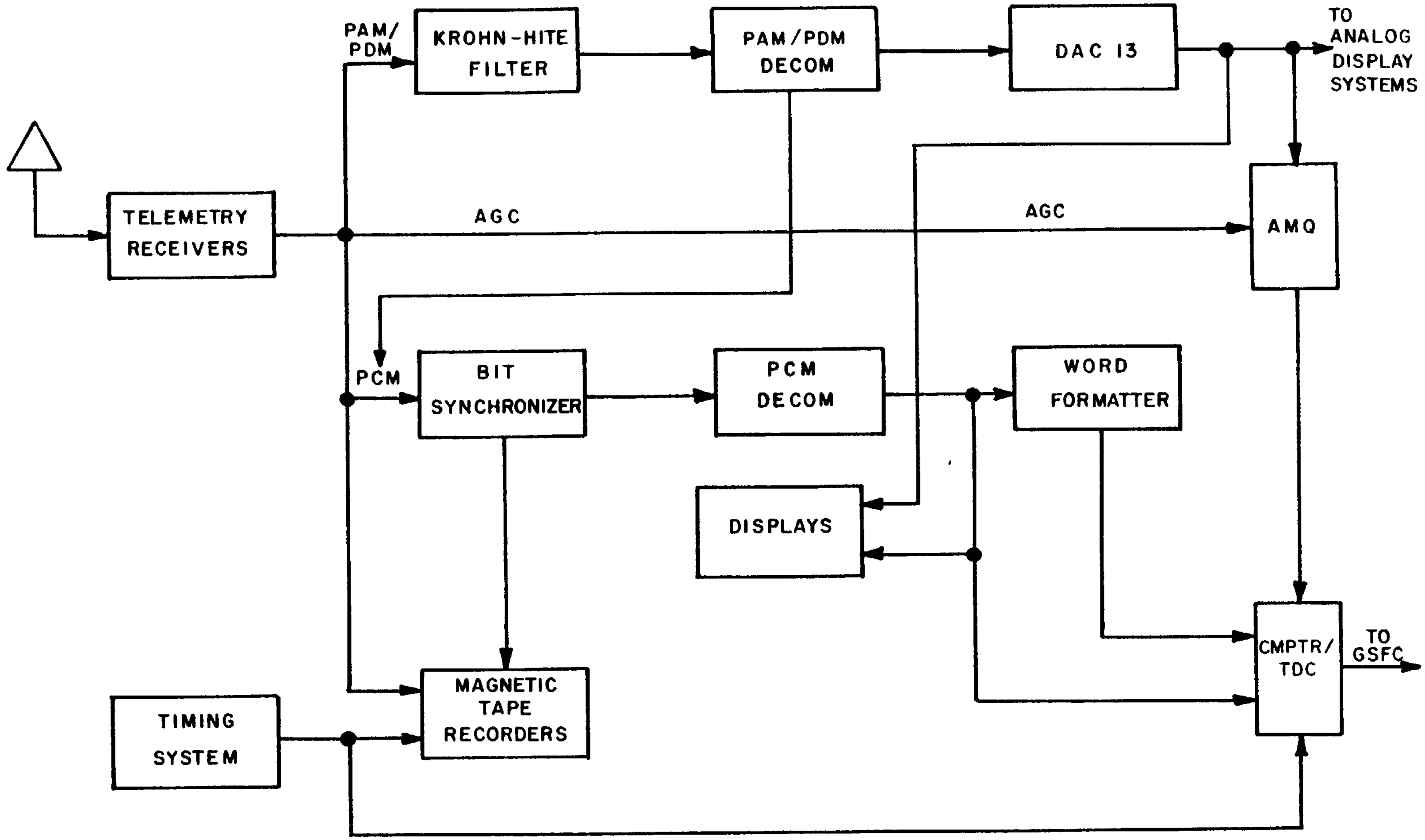
4.1.2 Underscored entries appearing in the Position column in tabular form for controls and indicators indicate nominal settings.

4.2 PCM DATA EQUIPMENT

4.2.1 GENERAL

4.2.1.1 PCM DHE is designed to accommodate codes in which information is transmitted in binary form; i.e., data is arranged in numerical form based on a radix of two. Since only two numbers (1 and 0) exist in this system, data streams consist of a series of on-off pulses: on representing one number, off representing the other. Various systems of arranging these on-off pulses have been devised,and some of the more common ones are shown in figure 4-2.

4.2.1.2 As shown in figure 4-1, PCM data paths within the DHE area follow a path beginning at the bit synchronizer, then proceeding through a PCM decommutator (which incorporates the display shown). Descriptions of the units used in the STDN are included in this section.



NOTE

IN SOME CASES TRANSMISSION OF DATA THROUGH COMPUTERS TO OFF-SITE DESTINATIONS MAY BE REPLACED WITH DIGITAL TRANSMISSION SYSTEMS (DTS) OR MSFTP-3 STANDALONE DATA MODEM CONFIGURATION.

Figure 4-1. Typical Data Handling Simplified Block Diagram

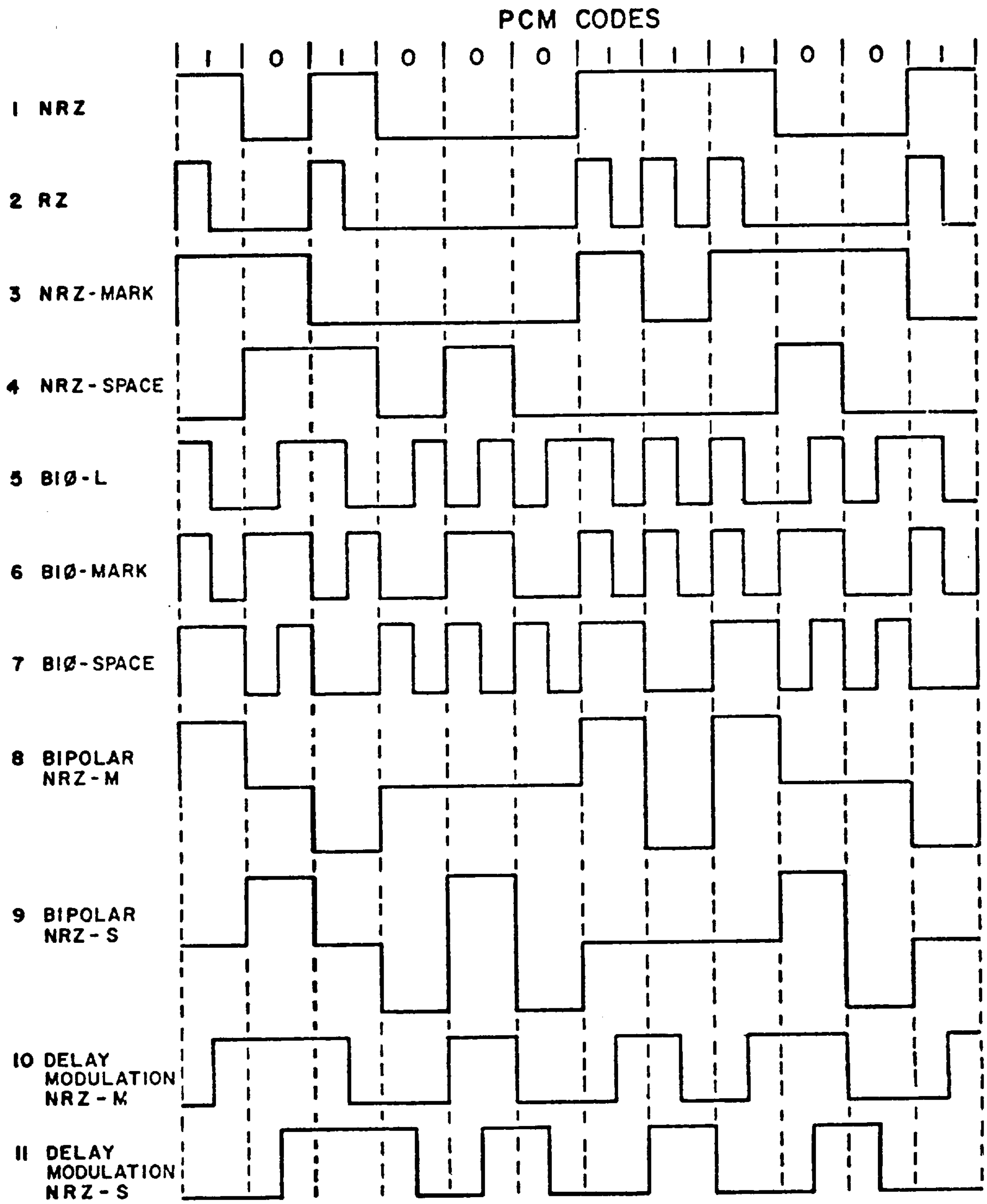


Figure 4-2. IRIG Standard PCM Data Codes

4.2.2 PCM BIT SYNCHRONIZERS

4.2.2.1 The bit synchronizer, as the initial element in the data handling stream, is critical to data handling operations. In general, its operation is as follows: The incoming pulse train (with attendant noise acquired through transmission) is applied to the input. Through averaging and/or sampling techniques, each incoming data pulse (bit) is analyzed and two functions are performed. First, the frequency (or bit rate) of the incoming data is established. Frequency determining circuits then automatically adjust the bit synchronizer frequency to synchronize itself (lock on) to the incoming bit rate. Second, the level of the pulses (high or low) is determined.

4.2.2.2 After these functions are accomplished, the bit synchronizer is capable of providing several outputs as follows:

a. A noise-free replica of the incoming pulse. (Auxiliary circuits may also convert the code from one type to another in some units.)

b. Clock signals (i.e., a signal, without data, at the same frequency as the incoming bit stream). These clock signals may be in phase with the input, or may be displaced by 90, 180, 270 degrees, or may be available at multiples or submultiples of the input frequency.

c. A "lock" signal indicating to the operator and/or other equipment that the system is synchronized with the incoming bit stream and processing data.

4.2.2.3 A representative diagram of the typical bit synchronizer is shown in figure 4-3.

4.2.2.4 Table 4-1 shows typical decommutator/bit synchronizer allocation.

4.2.2.5 Tables 4-2 through 4-7 list equipment characteristics, and tables 4-8 through 4-11 list front-panel controls and nominal settings.

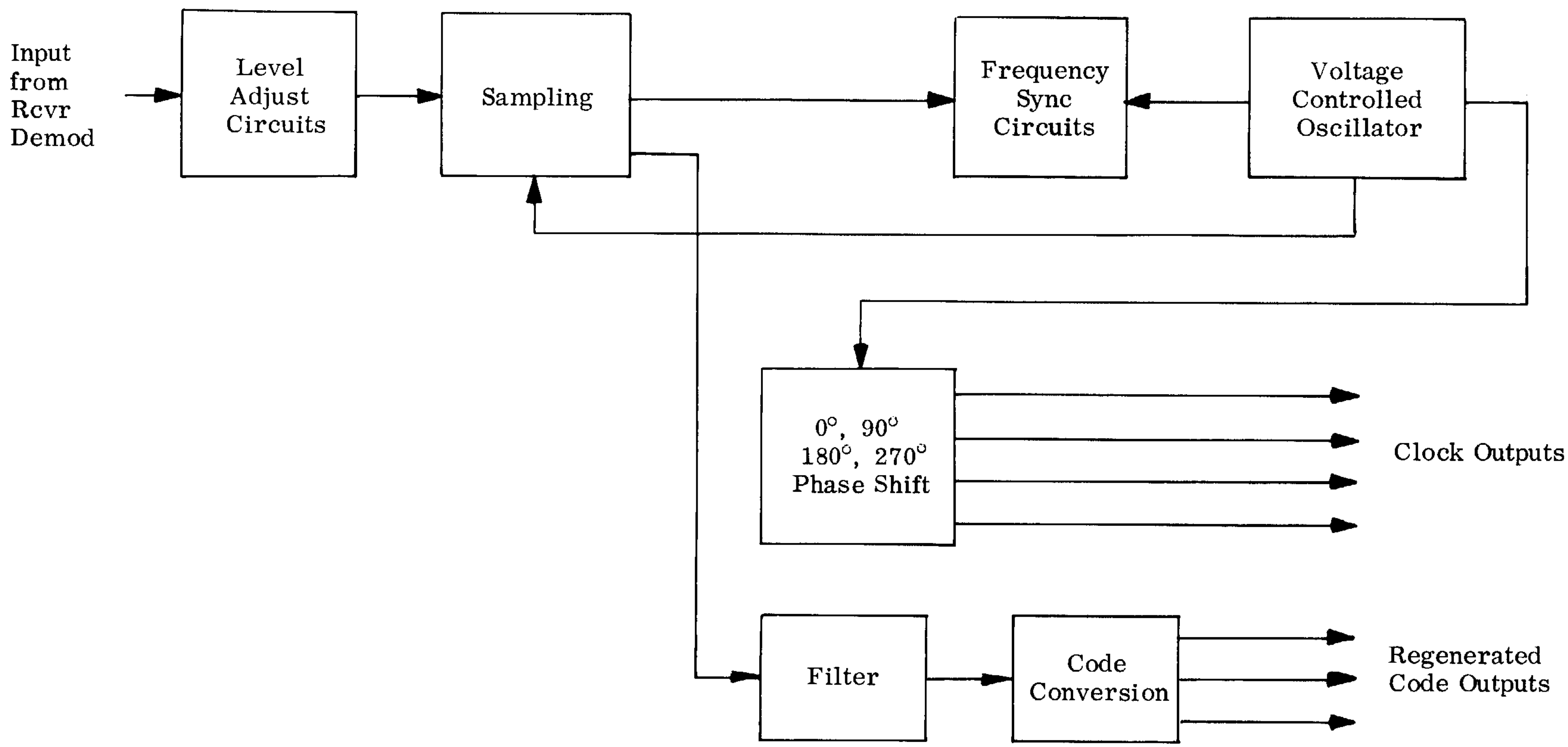


Figure 4-3. Simplified Diagram of a Bit Synchronizer

Table 4-1. PCM Decommutator/Bit Synchronizer Allocation*

System	Model 317	Model 317C	Model 317D	Model 319**	Model 330	Model 335
MSFTP-2			***		1 each for all stations	
MSFTP-3						2 each for all stations
DHS	1 each for all stations					
401 Frame Sync		1 each for all stations				
403 Frame Sync					1 each for all stations	

*This chart represents typical bit synchronizer allcation at most stations. Some stations may have different bit sync/decom configurations.

**Model 319 bit sync is unique for the Landsat program.

**Model 317D is used for MSFTP-2 systems until replaced by Model 330 bit sync.

Table 4-2. Model 317 Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 1.2 Mb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-M, NRZ-S, RZ, BiØ-M, BiØ-L BiØ-S.
Input Level	0.5 to 60 Vpp.
Input Impedance	10 kΩ min.
Outputs	NRZ-L, inverted NRZ-L, BiØ-L, and four clocks (0, 90, 180, and 270 degrees).
Detection	F/S (filter-sample) or I/D (integrate-dump).

Table 4-1. PCM Decommutator/Bit Synchronizer Allocation (1)

System	Model 317	Model 317C	Model 317D	Model 319 (2)	Model 330	Model 335
MSFTP-2			Note 3		1 each for all stations	
MSFTP-3						2 each for all stations
DHS	1 each for all stations					
DHE	Note 4	Note 4	Note 4	Note 4	Note 4	Note 4
401 Frame Sync		1 each for all stations				
403 Frame Sync					1 each for all stations	

Note

1. This chart represents typical bit synchronizer allocation at most stations. Some stations may have different bit sync/decom configurations.

2. Model 319 bit sync is unique for Landsat program.

3. Model 317D will be utilized for MSFTP-2 systems until replaced by Model 330 bit sync.

4. DHE at ROS and QUI have two Radiation 5220 bit syncs assigned. However, an impending EC will remove DHE at ROS and QUI.

Table 4-2. Model 317 Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 1.2 Mb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-M, NRZ-S, RZ, BiØ-M, BiØ-L BiØ-S.
Input Level	0.5 to 60 Vpp.
Input Impedance	10 kΩ min.
Outputs	NRZ-L, inverted NRZ-L, BiØ-L, and four clocks (0, 90, 180, and 270 degrees).
Detection	F/S (filter-sample) or I/D (integrate-dump).

Table 4-3. Model 317C Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 99.990 kb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-M, NRZ-S, RZ, BiØ-M, and BiØ-S, BiØ-L.
Input Level	0.5 to 60 Vpp.
Input Impedance	10 kΩ min.
Outputs	NRZ-L, inverted NRZ-L, BiØ-L, and four clocks (0, 90, 180, and 270 degrees).
Detection	F/S (filter-sample) or I/D (integrate-dump).
Quantized Data	2X data and 2X clock or 3X data and 3X clock.

Table 4-4. Model 317D Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 1.2 Mb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-M, NRZ-S, RZ, BiØ-M, and BiØ-S, BiØ-L, DM-M, DM-S.
Input Level	0.5 to 60 Vpp.
Input Impedance	10 kΩ min.
Outputs	NRZ-L, inverted NRZ-L, BiØ-L, and two clocks (0 and 90 degrees).
Detection	F/S (filter-sample) or I/D (integrate-dump).
Tape Outputs	2.8 Vpp (NRZ-L, BiØ-L, and 0-degree clock).
Modem Output	±6V (NRZ-L and 0-degree clock).

Table 4-5. Model 335 Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 5 Mb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-S, NRZ-M, RZ, BiØ-L, BiØ-M, BiØ-S, DM-M, and DM-S.
Input Level	0.5 to 60 Vpp.
Output	NRZ-L and four clocks (0, 90, 180, and 270 degrees).
Tape Recorder Output	NRZ-L and BiØ-L at 2.8 Vpp.

Table 4-6. Model 319 Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	15 Mb/sec NRZ-L data.
Input Code	NRZ-L.
Output	NRZ-L and three clocks (0, 90, and 180 degrees).

Table 4-7. Model 330 Bit Synchronizer Characteristics

Parameter	Characteristics
Input Bit Rate	Up to 1.2 Mb/sec for all acceptable codes.
Input Codes	NRZ-L, NRZ-M, NRZ-S, BiØ-S, BiØ-M, BiØ-L, RZ, DM-M, and DM-S.
Input Level	0.25 to 15 Vpp.
Input Impedance	10 kΩ min.
Output Codes	NRZ-L and BiØ-L with two clocks (0 and 90 degrees).
Tape Recorder Output	NRZ-L and BiØ-L, 0-degree clock.
Recorder Level	2.8 Vpp.
Model Output	NRZ-L and 0-degree clock ±8 Vpp.
Quantized Data	Either 2X or 3X.
Bit Rate Range for Quantized Data	5 to 100,000 b/sec.

Table 4-8. Monitor 317/317C Bit Synchronizer Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
LOOP BAND three-position rotary switch	1 (0.3%) 2 (1.0%) 3 (2.0%)	Selects one of three filter bandwidths for the phase-lock loop.
▼ BIT RATE* thumbwheel switches (5)		Selects bit rate from one bit to 1.2 million bits per second to correspond with input data rate regardless of input code. Switch selectable as four significant digits plus decade range.
MODE switch	MANUAL PROGRAM	Selects how the bit synchronizer is to be controlled. MANUAL position permits operation using front-panel controls; PROGRAM position permits operation using a program from a remote source.
TEST		Test points for selected locations in the unit including: input output NRZ-L, Biø-L, 0-degree clock, 90-degree clock, and ground.
OVERRIDE six-position rotary switch and momentary contact pushbutton	OFF	Permits the synchronizer to be controlled from the front panel during remote operation, i.e., permits override of a stored program for one of five functions. When the switch is positioned to a function, the manual selection of the function is written into the stored program when the OVERRIDE pushbutton is pressed.
COMMANDS indicators		Indicate the status of the bit synchronizer in either MANUAL or PROGRAM mode.
POWER ON switch	ON OFF	Applies power to the synchronizer. Indicator lights red when switch is set to ON.
INPUT AMPLITUDE meter	Operative	Indicates the amplitude of the incoming data.
LOSS indicator		Lights red when input signal amplitude is too low.
SYNC indicator		Lights green when the unit is synchronized.
RESET PB	Momentary	Used to reset the phase lock loop to 0 volt.
SOURCE rotary switch	Up to six positions	Selects one of up to six input sources.

▼ Specified in NOSP.

Table 4-8. Monitor 317/317C Bit Synchronizer Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
▼ CODE rotary switch	Seven positions	Selects one of seven PCM data codes: NRZ-S, M, or L, RZ, and BiØ-L, M, or S.
DET/POL** (Two concentric 2-position rotary switches)	F/S, I/D NORM, INV	Outer switch selects the type of detection-either filter and sample or integrate and dump. Inner switch is to match the logic sense of the input signal: NORM = true logic high INV = true logic low
OFFSET (+, -) indicator		Lights red when offset is outside synchronizer reference levels.
LOOP DEVIATION meter	Meter null	Indicates the phase lock loop error voltage.

▼ Specified in NOSP.

*Model 317C PCM bit synchronizer select bit rate from 1 bit to 99.990 kb/sec.

**Model 317C PCM bit synchronizer DET switch is marked 2X or 3X. This switch selects either the 2X or 3X quantized output; detection is always I/D which is not switchable.

Table 4-9. Monitor 335 and 317D Bit Synchronizers Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to the bit synchronizer.
POWER indicator		Lights when POWER switch is in ON position.
INPUT AMPLITUDE meter		Indicates relative amplitude of incoming data.
LOSS indicator		Lights when signal amplitude is too low.
OFFSET indicator		Lights when input signal is offset beyond unit capability.
SYNC indicator		Lights when unit is synchronized.
SOURCE switch	1 thru (	Selects input PCM data source.
▼CODE switch	NRZ-S NRZ-M NRZ-L RZ BIØ-L BIØ-M BIØ-S DM-M DM-S	Selects input PCM data codes.
POLARITY switch	+ -	Selects normal or inverted output to match sense of input signal.
SOURCE display		Displays input source selected.
POLARITY display		Displays the polarity selected.
CODE indicators		Indicates the input code selected.
LOOP display		Displays which one of four phase-locked loop filter bandwidths is selected.

▼ Specified in NOSP.

Table 4-9. Monitor 335 and 317D Bit Synchronizers Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
MANUAL/PROGRAM switch	MANUAL PROGRAM	Selects mode of operation. MANUAL position permits use of front-panel controls. PROGRAM position permits operation by programmable inputs from a remote source.
OVERRIDE PBI	Momentary	When pressed, transfers manual data selected by OVERRIDE switch into program registers during program mode operation.
OVERRIDE switch	OFF BIT RATE LOOP SOURCE CODE POLARITY	Selects parameter to be inserted from front panel into program registers during operation in program mode.
▼BIT RATE (5 thumbwheel switches)		Selects bit rate from 1 bit to 5 million bits per second to correspond with input data rate regardless of input code. Switch selectable as four significant digits plus decade range.
LOOP BAND switch	1 (0.1%) 2 (0.3%) 3 (1.0%) 4 (2.0%)	Selects one of four phase-locked loop filter bandwidths.
RESET PBI	Momentary	Used to reset phase-locked loop to 0 volt.
LOOP DEVIATION meter		Indicates direction and magnitude of phase-locked loop error voltage.
BIT RATE (5 displays)		Displays the selected bit rate.
EXTERNAL CLOCK indicator		Lights when external clock is present.
LAMP TEST switch	Momentary	Used to check all indicators for burned out lamps.
Monitor 317D Equivalent Controls and Indicators		
SOURCE switch	1 thru 6	Selects input PCM data source.
POLARITY indicators	N I	Display the polarity selected.
LOOP BAND switch	1 (0.3%) 2 (1.0%) 3 (3.0%)	Selects one of three phase-locked loop filter bandwidths.
LOOP RESET PBI	Momentary	Used to reset phase-locked loop to 0 volt.

▼Specified in NOSP.

Table 4-10. Monitor 319 Bit Synchronizer Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to equipment.
SOURCE switch	1 2 3 4 TEST	Selects input sources.
VCO ADJ. control	Variable	Adjusts VCO center frequency.
POLARITY switch	NORMAL INVERTED	Inverts data output.

Table 4-11. Monitor 330 PCM Bit Synchronizer Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	On Off	Applies power to the bit synchronizers.
POWER indicator		Lights red when power is on.
INPUT AMPLITUDE meter		Indicates relative amplitude of incoming data.
LOSS indicator		Lights red when input signal amplitude is too low.
OFFSET + indicator		Lights red when input signal is offset beyond unit capability.
SYNC indicator		Lights green when unit is synchronized.
SOURCE switch	1 thru 6	Selects input PCM data source.
▼ CODE switch	NRZ-S NRZ-M NRZ-L RZ BIØ-L BIØ-M BIØ-S DM-M DM-S	Selects input PCM data codes.
POLARITY switch	+ -	Selects normal or inverted output to match sense of input signal.
▼ CONV switch	2X 3X	Selects convolution soft decision bits and corresponding serial clock.
SOURCE display		Readout indicates input source selected.
CODE display		Displays PCM code format selected.
POLARITY indicators		Indicates polarity selected.
CONV indicators		Indicates either 2X or 3X soft-bit decision resolution.
SOURCE LOOP display		Displays which one of three phase-locked loop filter bandwidths is selected.
MANUAL/PROGRAM switch	MANUAL PROGRAM	Selects mode of operation of bit synchronizer. MANUAL position permits use of front-panel controls. PROGRAM position permits operation by programmable inputs from a remote source.

▼ Specified in NOSP when required.

Table 4-11. Monitor 330 PCM Bit Synchronizer Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
OVERRIDE PBI	Momentary	When pressed, transfers manual data selected by OVERRIDE switch into program registers during program mode operation.
OVERRIDE switch	OFF BIT RATE LOOP SOURCE CODE POLARITY CONV	Selects parameter to be inserted from front panel into program register during operation in program mode.
▼ BIT RATE switch	Five banks S9, S10, S11, S12, and S13	Thumbwheel switches used to select bit rates from 1 b/sec to 1 Mb/sec to correspond to input data rate. S13 is MSB, S11 is LSB, S10 is an indicator only, S9 is the multiplier.
LOOP BAND switch	1 (0.1%) 2 (1.0%) 3 (4.0%)	Selects one of three phase-locked loop filter bandwidths.
LOOP CALIBRATE switch	Momentary	Used to reset phase-locked loop to 0 volt and initiate AUTO-CAL which calibrates VCO to ±0.1% of dialed bit rate.
LOOP DEVIATION meter		Indicates direction and magnitude of phase-locked loop error voltage.
BIT RATE display		Readout indicates selected bit rate.

▼ Specified in NOSP.

4.2.3 PCM DECOMMUTATION EQUIPMENT

4.2.3.1 General. PCM decommutation equipment follows the bit synchronizers in the data stream. The decommutator system includes synchronizers which recognize incoming frame, subframe, or other synchronization pattern and, using the sync pattern as a reference point, select words from the format for display and/or printout. Data may also be passed along to a computer for further analysis or display, depending upon the system involved.

4.2.3.2 MSFTP-2 Decommutator

a. The MSFTP-2 is a programmable core memory decommutator. A total of 10 formats may be stored for switch selection from the decommutator control panel. The MSFTP-2 core memory system consists of 4096 thirty-six bit word locations.

b. Three inputs are available: manual simulator, stored program simulator, and bit synchronizer (bit sync input wired to NB position of selector switch, WB position open).

c. System outputs include the following:

(1) Two 30-bit computer buffers, one 64-bit binary display of which only the first 32 bits (top row) are wired for display.

(2) Two 6-digit decimal displays (displays from 3 to 20 bits, selectable by bits/word thumbwheel switch).

(3) Five groups of binary stores, each made up of four 10-bit registers, 127 digital stores (single bit on-off status) and 127 Digital-to-analog Converters (DAC) of which 63 are wired.

d. The actual number of DAC's, digital stores, and binary stores outputs interfaced varies from station to station.

e. Format program entry and memory core modification may be performed by 642B computer entry, paper tape input, or manual entry.

f. Figure 4-4 shows a simplified block diagram of the MSFTP-2 system, table 4-12 lists equipment characteristics, and table 4-13 lists front-panel controls.

g. Appendix F lists MSFTP-2 to 642B computer buffer patching instructions.

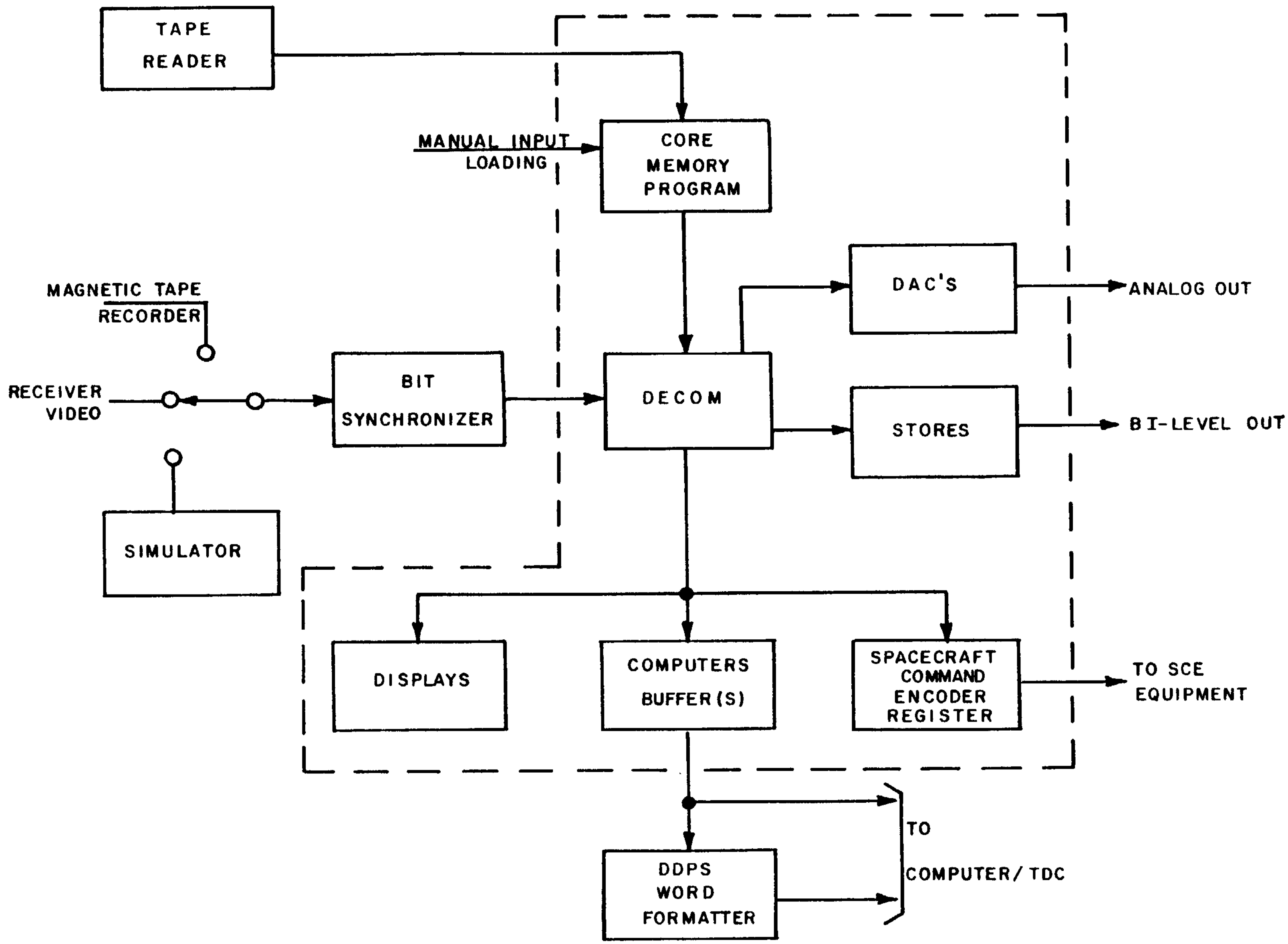


Figure 4-4. MSFTP-2 Simplified Block Diagram

Table 4-12. MSFTP-2 Decommutator Characteristics

Parameter	Characteristics
Synchronizer	
Bit Rate	Up to 1 Mb/sec.
Synchronizers	Six: Word, Frame, 3 ea subframe recycle, 1 ea subframe ID.
Modes	Search (Mode I), Check (Mode II), Lock (Mode III).
Serial-to-parallel Conversion	32 bits.
Decommutation Syllable Length	1 to 16 bits.
Decommutation Word Length	1 to 64 bits.
Program Controller	
Operation Cycle Time	1.923 microseconds.
Storage System	Magnetic core memory.
Storage Capability	4096 x 36 bits (10 PCM formats).
Memory Cycle Time	1.9 microseconds (clear-write and read-restore).
Parallel Word Output	32 bits.
P.O. Logic Levels (across 50 ohm)	0 volt ±0.5 (High). -6 volts ±1 (Low).
Digital Stores	124 single bit storage. Register outputs (relay contacts).
Computer Buffers	Two 30-bit outputs.
C.B. Logic Level (across load)	0 volt ±0.5 (High). -4 to -15 volts (Low).
Digital-to-analog Converter	63 outputs (not all interfaced).
DAC Bits Converted	8 bits.
DAC Range	0 to +10 V.

Table 4-13. MSFTP-2 Decommutator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
FORMAT SELECT LOCAL	LOCAL	Allows front-panel control.
COMPUTER/LOCAL	COMPUTER LOCAL	Allows front-panel control or computer control.
COMPUTER/REMOTE	COMPUTER REMOTE	Allows computer or DSCC control.
	REMOTE	Allows DSCC control.
▼1-2-3-4-5-6-7-8-9-10 switch	1 2 3 4 5 6 7 8 9 10	Selects desired format in memory.
CHANGE PB	Momentary	Press when desiring to change formats.
Status Controls		
MAN SIM/SP SIM/ WIDE/NAR switch	MAN SIM SP SIM WIDE NAR	Selects decom input signal.
OPERATE/LOAD/ TEST switch	OPERATE LOAD TEST	Selects decom operational mode.
CLOCK STOP PB	Momentary	Stops master clock when in test mode.
SYSTEM RESET PB	Momentary	Resets all counters and registers.

▼ Specified in NOSP.

Table 4-13. MSFTP-2 Decommutator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Program Entry		
CMPTR/TAPE 5/ TAPE 8	CMPTR TAPE 5 TAPE 8	Selects input source for program entry.
LOAD TAPE PB	Momentary	Starts tape reader.
STOP TAPE PB	Momentary	Stops tape reader.
ERROR STOP switch	ON OFF	Program loading stops on input parity error.
MEMORY ADDRESS switch	0000-7777	Selects memory address for display.
LOAD PB	Momentary	Loads memory from front panel.
READ PB	Momentary	Reads out memory on front-panel display.
CLOCK PB	Momentary	Starts clock or stops clock as determined by self-test control panel.
Parity		
DISPLAY/OFF switch	DISPLAY OFF	Displays memory parity errors and associated addresses when in DISPLAY position.
RESET PB	Momentary	Resets error indicator and allows memory address indicator to be up-dated.
Data Monitor		
CHANNEL ADDRESS control	Variable	Used to select memory addresses for downlink word display.
BITS CONVERTED control	Variable	Determines how many bits from a downlink word will be displayed.
SEL CHAN/ID/OFF switch	SEL CHAN OFF ID	Used to select input to the display.
Frame		
▼ 01 BITS control	Variable 0-9	Selects bit errors for search mode level 1.
▼ 02 BITS control	Variable 0-9	Selects bit errors for search mode level 2.
▼ PATTERNS II control	Variable 1-19	Used to select number of sequential good patterns required in mode II.

▼ Specified in NOSP.

Table 4-13. MSFTP-2 Decommutator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Frame (cont)		
▼ BITS II control	Variable 0-9	Used to select bit error tolerance for mode II.
▼ PATTERNS III control	Variable 1-19	Used to select number of sequential bad patterns before switching back to mode II.
▼ BITS III control	Variable 0-9	Used to select bit error tolerance for mode III.
Sub Frame * I-II-III		
BITS I control	Variable 0-9	Selects bit tolerance for subframe sync mode I.
PATTERNS II control	Variable 1-19	Selects number of sequential good patterns before going to mode III.
BITS II control	Variable 0-9	Selects bit tolerance for mode II.
PATTERNS III control	Variable 1-19	Selects number of sequential bad patterns before returning to mode II.
BITS III control	Variable 0-9	Selects bit tolerance for mode III.
RST PB	Momentary	Resets applicable synchronizer.
Word*		
BITS II control	Variable	Used to select bit error tolerance to determine when to switch to lock mode.
PATTERNS II control	Variable 1-19	Selects number of sequential patterns checked before switching to lock mode.
PATT ERR III control	Variable 1-19	Selects number of sequential bad patterns checked before switching to search mode.
PATTERNS III control	Variable 1-19	Selects number of sequential patterns checked in word sync mode.
ID*		
PATT ERR III control	Variable 1-19	Number of bad ID sync patterns checked before dropping out of lock mode.
COMP DET switch	IN PGRM OUT	Controls operation of data inversion circuits.

▼ Specified in NOSP.

* Will be specified in NOSP if required.

Table 4-13. MSFTP-2 Decommutator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Error Display		
FRAMES CHECKED control	Variable	Used to select total number of frames to be checked for errors.
WORD PARITY/FRAME SYNC switch	WORD PARITY FRAME SYNC	Selects type of errors to be counted.
READ CONTINUOUS/STOP switch	READ CONTINUOUS STOP	Determines operation of error display.
RESET PB	Momentary	Resets error display.
Sync Validity		
▼ FS III ERRORS switch	0-5	Selects sequential mode III pattern error tolerance of frame sync.
RELAY INHIBIT switch	INHIBIT OFF	Inhibits "store" relays.
▼ COMP 1 INHIBIT switch	INHIBIT OFF	Inhibits data to computer No. 1.
▼ COMP 2 INHIBIT switch	INHIBIT OFF	Inhibits data to computer No. 2.
▼ TAPE PLAYBACK C1 switch	C 1 OFF	Sets tape playback bit to computer No. 1.
▼ TAPE PLAYBACK C2 switch	C 2 OFF	Sets tape playback bit to computer No. 2.
Memory Display		
Toggle (36 switches)	1 0	Allows manual changes to memory addresses.
D-A Control Panel		
D-A1-24, 25-48, 48-72	DATA CAL	Selects external input or internal test voltage.
NORM/INV	NORM INV	Inverts polarity of incoming data.
OFFSET select	NONE A B	Provides a voltage offset to zero and full scale values.

▼ Specified in NOSP.

4.2.3.3 MSFTP-3 Decommutator

a. The MSFTP-3 (Monitor Corporation Model 1025) is a programmable core memory decommutator. A maximum of 32 different programs may be stored in memory. Two memory sizes are available: 8192 x 36 and 16,384 x 36.

b. Six inputs are available: one input from each of two external bit synchronizers, three direct external inputs, and one direct input from the MSFTP-3 serial output. A remote position is available to enable selection of any of the six inputs using the Monitor Model G121 remote display/control.

c. The system outputs include three 30-bit computer buffers, a 32-bit binary display, two 6-digit decimal displays (up to 20 bits converted), 31 DAC's, four 10-bit binary stores, thirty-one 1-bit digital (event) stores, a 15-column 20-line-per-second printer capable of 11 different display formats, two 32-bit parallel data outputs to external devices such as the SCE, and a serial output capable of generating an infinite variety of serial data.

d. The number of DAC, digital store, and binary store outputs actually interfaced varies with each station.

e. All MSFTP-3 systems have been modified to allow processing GMT in the accumulator. This allows time-tagging specified points in the data stream to a microsecond granularity.

f. Figure 4-5 shows a simplified block diagram of the MSFTP-3 system, table 4-14 lists equipment characteristics, and table 4-15 lists front-panel controls and indicators.

g. Appendix G lists MSFTP-3-to-642B computer buffer patching instructions.

h. A number of MSFTP-3 decommutators have been modified by EC 1336 to allow simultaneous decommutation of up to four serial data streams. Modifications are as follows:

(1) Additional front-panel controls and displays have been added to the Central Control Unit (CCU). These controls and displays are listed in table 4-15A.

(2) A priority interrupt system has been added to handle the simultaneous input of the four data streams.

(3) Four index registers, four instruction registers, four program counters, one mark register, and an A-save register have been added as additional hardware to support the four frame sync subroutines.

i. MSFTP-3's with such modifications are known as multi-input MSFTP-3's.

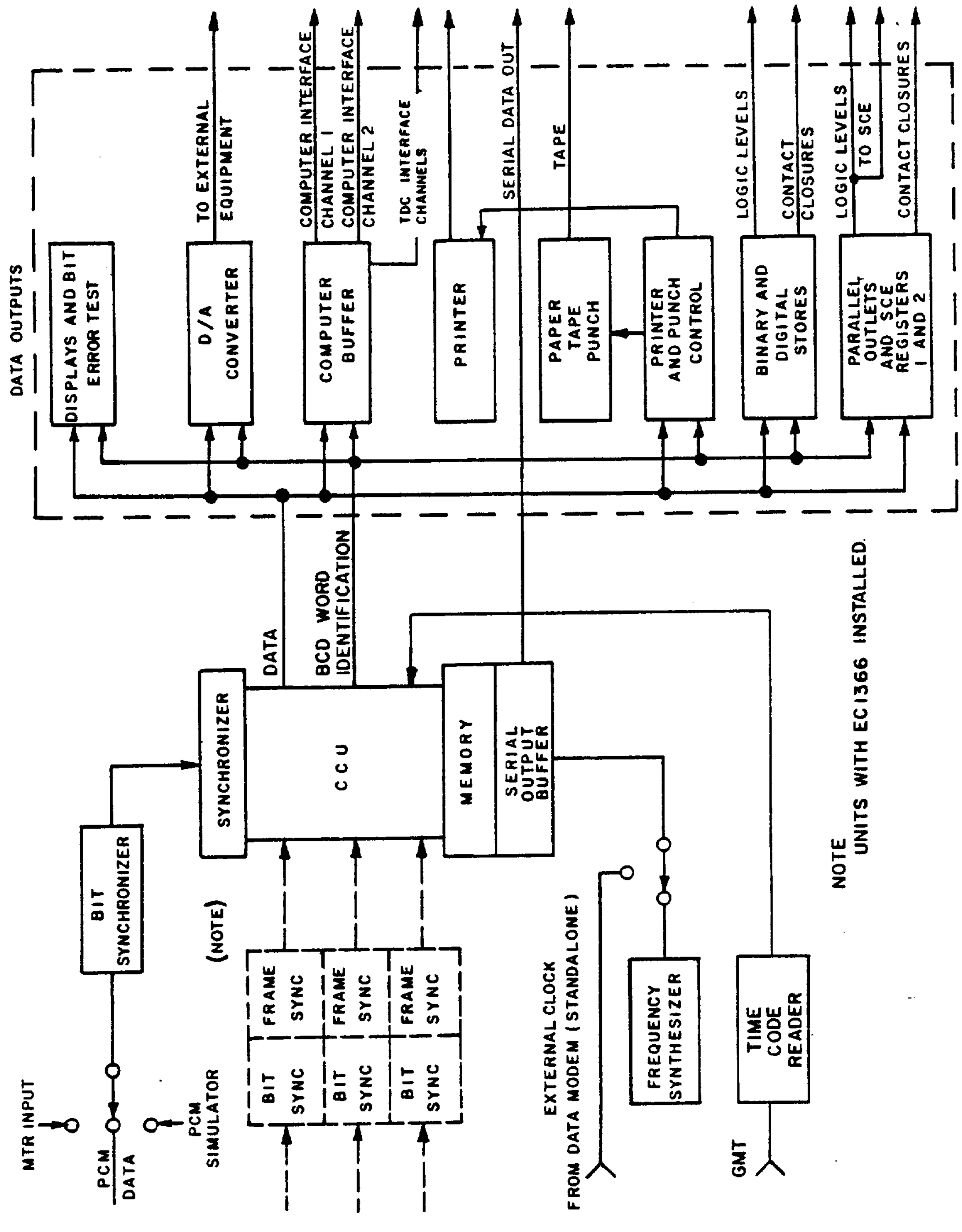


Figure 4-5. MSFTP-3 Simplified Block Diagram

Table 4-14. MSFTP-3 Decommutator Characteristics

Parameter	Characteristic
<u>Synchronizer</u>	
Bit Rate	Up to 5 Mb/sec.
Synchronizers	Frame plus 5 subframe or sub-subframe (recycle or I.D.).
Modes	Search, check, lock.
Word Length	4 to 32 bits for sync and data.
Clock Rate	20 MHz.
Programs	32 stored programs.
Memory Size	8.192 x 36 or 16 k x 36 bits per word (35 data plus 1 parity).
Memory Access Time	300 nanoseconds.
Memory Cycle Time	800 nanoseconds.
<u>System Outputs</u>	
Parallel Word Output	32 data bits plus 1 strobe per set; 2 sets, A and B.
P.O. Logic Levels	0V/+5V or 0V/-6V, switch selectable.
Digital Stores	31 (relay contacts).
Computer Buffers (3 each)	To 30-bit data plus 3 control lines.
C.B. Logic Levels	
Channels 1 and 2	Univac 642B fast interface.
Channel 3	TDC interface.
Printer	20 lines/sec, 15 columns.
Serial Data	1 output (2 buffers).
Serial Data Levels	+6/-6V.
DAC's	31.
DAC Bits Converted	8 bits.
DAC Range	0 to 10 V (offset available).
Punch	ASCII numerals with parity.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Central Control Unit		
FORMAT-ID display		Displays format identification. Programmable by setup instruction.
FORMAT-LOCATION display		Displays memory location containing first instruction of program. Programmable by setup instruction.
OVFL indicator		Indicates that CPU was still processing previous word when a word time pulse was received and is now halted.
▼ SELECT thumbwheel switches	00-37	Select binary address of memory location containing one of 32 jump instructions. Instruction will cause CPU to jump to memory location containing selected program.
INITIATE pushbutton		Initiates fetch of instruction in memory location specified by SELECT thumbwheel switches.
MASTER RESET pushbutton		Resets and clears entire system.
ADDRESS DISPLAY numerical display		In step, command, and manual modes, displays contents of selected register. In selected halt and normal modes, displays address of parity error.
ADDRESS thumbwheel switches		Select address to be entered into selected register in manual mode.
SELECTED REGISTER selector switch		In step, command, and manual modes, selects register to be displayed or loaded (manual mode only).
ENTER pushbutton		In manual mode, loads selected register with contents of thumbwheel switches.
DATA DISPLAY/ 34 through DATA DISPLAY/0 PBI's		In step and command modes, displays contents of selected data register. In manual mode, displays contents of selected data register only after READ pushbutton is pressed. Pressing any data pushbutton will toggle that data bit. In selected halt and normal modes, displays words with parity errors.

▼ Specified in NOSP.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Central Control Unit (cont)		
▼ SENSE - 1 toggleswitch ▼ SENSE - 2 toggleswitch ▼ SENSE - 3 toggleswitch ▼ SENSE - 4 toggleswitch	Up Down	When up, satisfies the sense (1, 2, 3, 4) jump condition When down, satisfies the not sense (1, 2, 3, 4) jump condition.
RESET pushbutton		Resets the data display.
PARITY ERROR PBI		Indicates a parity error is detected in word being read from memory. Press to reset to off condition.
▼ STOP/RUN toggle switch	RUN STOP	When set to RUN, program continues operation when parity error occurs. When set to STOP, program stops on error.
DATA DISPLAY selector switch (may be enabled in run mode by an internal CCU switch)		In step, command, and manual modes, selects the register to be displayed at the data display.
ENTER pushbutton		In manual mode, enters contents of register selected by DATA DISPLAY selector switch into DATA DISPLAY indicators.
RUN PBI		Starts instruction execution. Green indicator is lit when system is operating under program control.
HALT PBI		Stops instruction execution. Yellow indicator is lit when CCU is not executing program instructions.

▼ Specified in NOSP.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Central Control Unit (cont)		
MODE selector switch	HALT MANUAL COMMAND STEP NORMAL	Selects mode of CCU operation. In selected HALT MODE, program will halt when the address thumbwheel switches equal the current memory address. In MANUAL MODE, registers and memory may be examined and altered. In COMMAND and STEP MODES, selected address and data registers are displayed and instructions are executed at a rate determined by the rate selector. In COMMAND MODE, word time pulses must be received from the synchronizers to force the CCU from a wait state. In STEP MODE, instruction wait bits are ignored.
RATE PPS selector switch	.1 1 10 100 SINGLE STEP	Selects instruction execution rate in COMMAND and STEP MODES. Selects trigger clock pulse rate for single step operation (controlled by SINGLE STEP pushbutton), 0.1 to 1 p/sec range, 1 to 10 p/sec range, 10 to 100 p/sec range, and 100 to 1000 p/sec range, each range variable with rotation of RATE PPS potentiometer.
RATE PPS potentiometer		In positions .1, 1, 10, and 100 of RATE PPS selector switch, rotation adjusts the rate of execution of program instructions to any value between the rate indicated by switch setting and new higher rate.
SINGLE STEP pushbutton		Executes a single program instruction when RATE PPS selector switch is in SINGLE STEP position.
TEST STEP display		Numerical display provided for programmable use as required. Generally used under diagnostic program control to display TEST STEP currently being executed.
GO indicator		Green indicator lights in response to setup instruction in diagnostic program.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Central Control Unit (cont)		
NO-GO indicator		Red indicator lights in response to setup instruction in diagnostic program.
▼ STOP ON ERROR/RUN toggle switch	STOP ON ERROR RUN	When in STOP ON ERROR position, satisfies the stop-on-error jump condition.
LAMP TEST pushbutton		Lights all indicators on CCU, SYNC, and I/O panels.
SELF TEST UNIT indicators		White indicator lights for unit or equipment section selected by setup instruction in diagnostic program.
Synchronizers and I/O Control		
ACTIVE indicator		Amber light indicates serial data is being transmitted.
▼ EXT/FREQUENCY SYNTHESIZER toggle switch		Selects the serial data clock from an external source or from the frequency synthesizer.
FR/SEARCH PBI		Red light indicates frame synchronizer is in the search mode. Pressing the pushbutton will return the synchronizer to the search mode.
FR/LOCK indicator		Green light indicates the frame synchronizer is in the lock mode.
SF1/SEARCH through SF5/SEARCH indicators and pushbuttons		Red light indicates the associated subframe synchronizer is in the search mode. Pressing the pushbutton will return the synchronizer to the search mode.
SF1/LOCK through SF5/LOCK indicators		Indicate the associated subframe synchronizer is in the lock mode.
SF1/ID through SF5/ID indicators		Indicate the associated subframe synchronizer is operating in the ID mode.
SF1/RECYCLE through SF5/RECYCLE indicators		Indicate the associated subframe synchronizer is operating in the recycle mode.

▼ Specified in NOSP.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Synchronizers and I/O Control (cont)		
TAPE/COMPUTER I/O-TAPE indicator		White indicator lights when TAPE/ COMPUTER switch is in TAPE position or when tape I/O is remotely selected.
TAPE/COMPUTER I/O toggle switch	TAPE CMPTR	In TAPE position, enables paper tape program input/output to CCU memory. In CMPTR position, enables input/ output from external computer (through input buffer logic).
TAPE/COMPUTER I/O -CMPTR indicator		White indicator lights when TAPE/ COMPUTER switch is in CMPTR position, or when computer I/O is remotely selected.
TAPE/COMPUTER I/O-ACTIVE indicator		Amber ACTIVE indicator flashes when computer input/output is in progress.
TAPE LOAD-PARITY ERROR PBI		Red indicator lights during tape loading sequence if an error in character parity occurs.
TAPE LOAD switch	STOP RUN	In STOP position, halts operation of paper tape reader when parity error is detected. In RUN position, operation of paper tape reader continues even when parity error is detected.
AUTO DATA INVERSION selector switch	PROGRAM DISABLE ENABLE	In PROGRAM position, automatic data inversion will be enabled or disabled according to the frame synchronizer's setup instruction. In DISABLE position, automatic data inversion is disabled. In ENABLE position, the automatic data inversion is enabled.
DECOM INPUTS selector switch	REMOTE 1-6	Seven-position rotary switch. When not in the REMOTE position,this switch provides manual selection of input data and its associated bit rate clock. In the REMOTE position,input data and CLK will be selected remotely.
SELECTED INPUT indicators		White indicators indicate the selected input data and clock source.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
<u>I/O Control</u> (cont)		
TAPE LOAD-START pushbutton		Starts tape reader operation and loads program from tape into CCU core memory until end-of-message character is detected.
TAPE LOAD-STOP pushbutton		Stops tape reader.
DAC-INHIBIT indicator		Red light indicates inputs to the D-A converter are inhibited.
DAC toggle switch	ON OFF	The ON position inhibits inputs to the D-A converter provided the DECOM INPUTS switch is not in the REMOTE position where the inhibiting is controlled remotely.
FORMAT CHANGE - INHIBIT indicator		Indicates the jump on equality + auto format change jump condition is inhibited.
FORMAT CHANGE toggle switch	ON OFF	The ON position inhibits execution of the jump on equality + auto format change instruction, provided the DECOM INPUTS switch is not in the REMOTE position where the inhibiting is controlled remotely.
BINARY STORES - INHIBIT indicator		Red light indicates inputs to the binary stores are inhibited.
BINARY STORES toggle switch	ON OFF	The ON position inhibits inputs to the binary stores provided the DECOM INPUTS switch is not in the REMOTE position where the inhibiting is controlled remotely.
BINARY STORES RESET pushbutton		Resets binary stores to all 0's.
BY-PASS indicator		Red light indicates SYNC BY-PASS has been enabled.
SYNC BY-PASS selector switch	BY-PASS <u>NORMAL</u>	In BY-PASS position, all synchronizers are held in SEARCH and data is transferred to the CCU with word lengths equal to the common length. In NORMAL position data will be transferred to the CCU once the frame synchronizer has entered the lock mode.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
I/O Controls (cont)		
BINARY STORES - TEST pushbutton		Presets binary stores to all 1's.
DIGITAL STORES INHIBIT indicators		Red light indicates inputs to the digital stores are inhibited.
DIGITAL STORES toggle switch	ON OFF	The ON position inhibits inputs to the digital stores provided the DECOM INPUTS switch is not in the REMOTE position where the inhibiting is controlled remotely.
DIGITAL STORES - RESET pushbutton		Resets digital stores to all 0's.
DIGITAL STORES-TEST pushbutton		Presets digital stores to all 1's.
COMPUTER BUFFER 1-INHIBIT indicator		Red light indicates the computer buffer No. 1 is inhibited.
▼ COMPUTER BUFFER 1 switch	ON OFF	The ON position inhibits data requests and interrupts to the external computer.
COMPUTER BUFFER 1-NIA indicator		Red light indicates the computer has not responded to two successive input requests.
COMPUTER BUFFER 1-PLAYBACK BIT indicator		Amber light indicates the tape playback bit is set.
▼ COMPUTER BUFFER 1-PLAYBACK BIT switch	UP DOWN	Up position sets tape playback bit.
COMPUTER BUFFER 2-INHIBIT indicator		Red light indicates computer buffer No. 2 is inhibited.

▼ Specified in NOSP.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
I/O Control (cont)		
COMPUTER BUFFER 2 switch	ON OFF	ON inhibits data requests and interrupts to the external computer.
COMPUTER BUFFER 2-NIA indicator		Red light indicates the computer has not responded to two successive input requests.
COMPUTER BUFFER 2-PLAYBACK BIT indicator		Amber light indicates the tape playback bit is set.
▼COMPUTER BUFFER 2-PLAYBACK BIT switch	UP DOWN	UP sets tape playback bit.
Punch Control		
START ADDRESS switch		Selects start address of memory data to punch.
STOP ADDRESS switch		Selects stop address of memory data to punch.
ENABLE/DISABLE toggle switch	ENABLE DISABLE	Controls power to punch mechanism, and ENABLE indicator DS1.
INITIATE DUMP pushbutton		Initiates memory dump from memory location as specified by the START and STOP ADDRESS thumbwheel switches.
ENABLE indicator		When on, indicates that punch control is enabled and that ac power is provided to the punch.
Printer		
Power	ON OFF	ON if required as specified in NOSP; otherwise OFF.
On line	OFF	Must be ON to print.
Paper Advance pushbutton	Momentary	Press to advance paper.

▼Specified in NOSP.

Table 4-15. MSFTP-3 Decommutator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Print Test		
Synthesizer	ON OFF	Applies power.
Power Bit Rate	Variable	Used to select desired synthesizer output bit rate.
COMPUTER BUFFER 3- INHIBIT indicator		Amber light indicates that computer buffer No. 3 is inhibited.
▼COMPUTER BUFFER 3 switch	ON OFF	ON inhibits data requests and interrupts to the external computer.
COMPUTER BUFFER 3 IA-indicator		Red light indicates the computer has not responded to input requests.
▼Specified in NOSP.		

Table 4-15A. Multi-input MSFTP-3 CCU Added Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
▼ MULTI toggle switch	ON	Selects the multi mode of operation.
	OFF	Selects the normal mode of operation.
MULTI indicator		Indicates that the MULTI toggle switch is set to ON.
NORMAL indicator		Indicates that the MULTI toggle switch is set to OFF.
FRAME LOCK indicators FS1 FS2 FS3 FS4		Indicates that the associated frame sync is interrupting the CCU.
SELECTED indicator FS1 FS2 FS3 FS4		Indicates that the associated ENABLE toggle switch is set to ON and the software has enabled interrupts from the frame sync.
▼ ENABLE toggle switch FS1 FS2 FS3 FS4	ON	Manually enables the frame sync to interrupt the CCU.
	OFF	Manually disables the the frame sync from interrupting the CCU.
OVFL PBI's FS1 RESET FS2 RESET FS3 RESET FS4 RESET		Indicates that the CCU received an interrupt prior to acknowledging the previous interrupt received. When pressed, resets the overflow indication.
M PRO toggle switch	up	Enables manual display of the processor mark register.
	down	Enables manual display of the frame sync mark register.

▼ Specified in NOSP.

4.2.3.4 Dynatronics PCM/DHS

a. The Dynatronics PCM/DHS is a programmable core memory decommutator. Any number of different programs may be stored in its 4096 x 36-bit memory. The lowest 16 addresses are selectable by an external computer for initiation; these addresses commonly contain jump instructions to access programs stored outside this area. Manual initiation can access any core location.

b. Three inputs are available: one from the system simulator, one from an external bit synchronizer, and a direct external input.

c. The systems outputs include a 32-bit binary display and twenty 3-digit channel selectors (each converts up to 9 bits per syllable). These are activated by thumbwheel-selected data tags which are programmed in the software. The channel selectors can display in either octal or decimal. Other system outputs are: 20 DAC's which are associated with the channel selectors, plus thirty-two program-selected DAC's; 127 event stores; two 32-bit computer buffers; a 32-bit parallel output (generally interfaced with the SCE system); seven channel-stripping pulses (used to generate various strobes); a line printer; and a five-channel paper-tape punch which can be used either to output data or to dump memory contents. In addition, one of the computer buffers is capable of serially outputting selected downlink data at a bit rate which is a binary submultiple of the input bit rate.

d. The interfacing of the DAC's, parallel outputs, channel stripping pulses, and event stores to external equipment varies from station-to-station. The DHS has been interfaced to the 642B computer through a level shifter and a DDPS word formatter. Selected stations may also have their DHS interfaced to a Honeywell DDP-516 computer through a computer buffer.

e. The PCM/DHS system includes a stored-program simulator with a 4096 x 24-bit memory. Its versatile instruction set allows an infinite number of possible serial PCM data stream outputs. Initiation of a simulator program is similar to that described for the decom in para a.

f. Both the decom and simulator memories are programmable by either paper tape, computer-generated inputs, or manually.

g. Figure 4-6 shows a simplified block diagram of the DHS system, table 4-16 lists equipment characteristics, and table 4-17 lists front-panel controls and indicators.

h. Appendix H lists DHS-to-642B computer buffer patching instructions. For DHS-to-DDP-516 computer buffer patching, refer to the applicable NOSP.

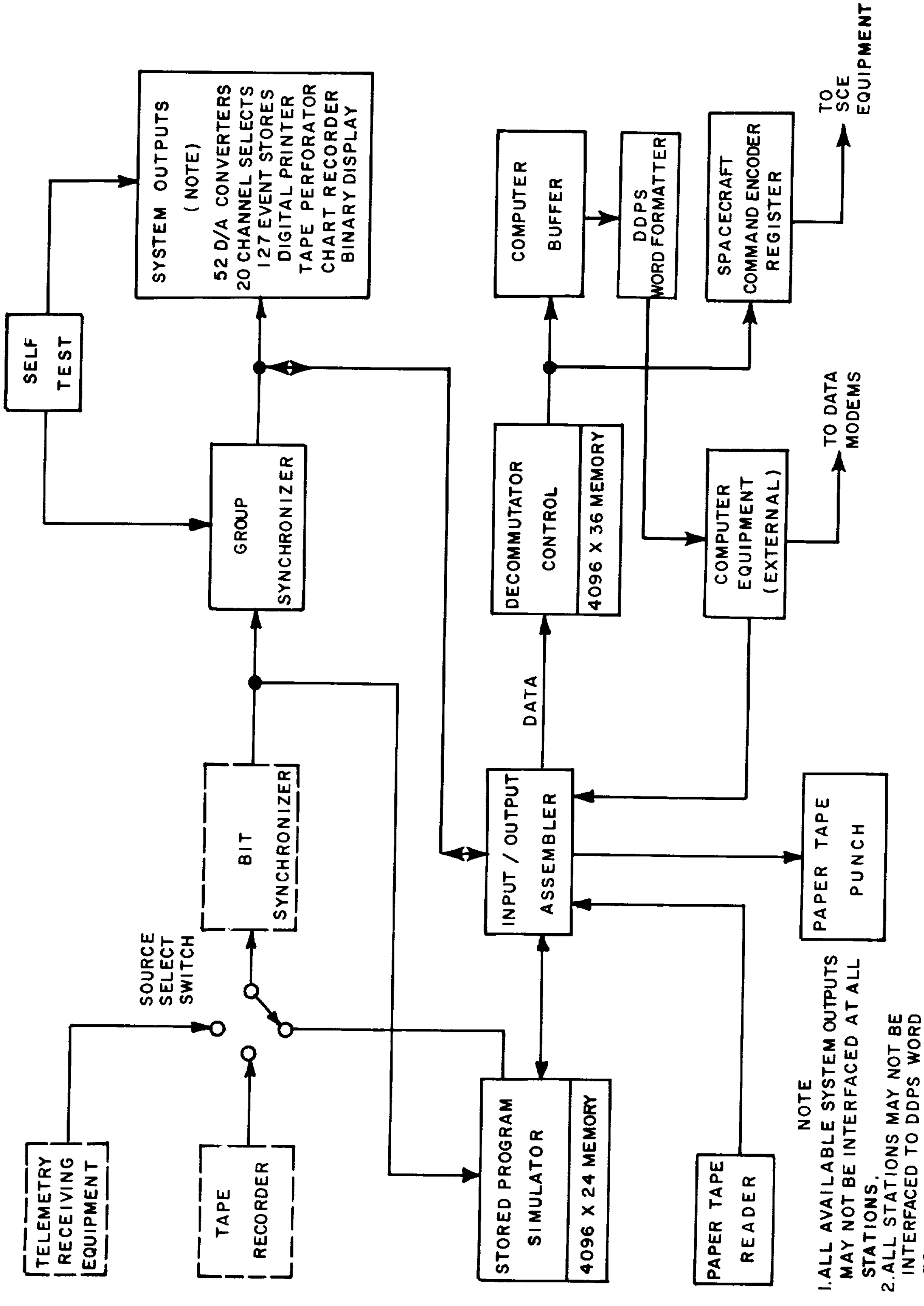


Figure 4-6. Dynatronics PCM-DHS Functional Block Diagram

Table 4-16. DHS Characteristics

Parameter	Characteristics
<u>Synchronizer</u>	
Bit Rate	Up to 1 Mb/sec.
Synchronizers	Word, Frame, Subframe 1 thru 3 (recycle or I.D.).
Modes	Search, Check, Lock.
Word Length	1 to 32 bits; programmable.
Memory	4096 words; 36 bits/word.
Memory cycle time	1 microsecond.
Data Tag	11-bit field specified under program control to identify each data word 16 stored formats.
<u>System Outputs</u>	
Parallel Word Bus	32 bits MSB justified.
Digital Stores	127 discrete events (relay closures).
Computer Buffers	2 each 37-bit outputs.
Digital-to-analog Converter	32 outputs under program control, 20 outputs from channel select displays.
Oscillograph	8 channel plus markers.
Punch	5-level.
Printer	40 column; 40 lines/sec.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Simulator System Control Panel		
MEMORY DATA PBI's (24)		Used to display contents of specific memory addresses and to manually load data into selected memory addresses.
PROGRAM SELECT octal indicators		Display the octal number assigned to simulation program in use.
LOCAL/REMOTE switch	LOCAL REMOTE	In LOCAL position, a simulator program may be started from the simulator control panel. In REMOTE position, a simulator program may only be started by a remote device such as a computer.
MEMORY PARITY		
ERROR PBI	Momentary	Lights red when a memory parity error is detected.
ERROR DISPLAY switch	ON OFF	Causes inputs from external devices to be inhibited when a memory parity error is detected.
MODE SELECT		
MODE SELECT switch		Four-position selector switch used to select the simulator operating mode.
	DUMP	DUMP position is used to dump the contents of a specific area of memory to an external system, such as a computer. The starting address is selected on the MEMORY ADDRESS thumbwheels (LOCAL mode) or is specified by the external system (REMOTE mode), and the stop address is selected on the BLANKING REFERENCE ADDRESS thumbwheels. The contents of all sequential locations and the parallel address lines are supplied as an output. If the starting address contains a JMP, the JMP is the first output, the effective address of the JMP is next, followed by all sequential locations up to and including the selected stop address.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator System Control Panel (cont)		
MODE SELECT switch (cont)	SIM	SIM position is used when executing an operational simulation program, e.g., generating a PCM format.
	TEST	TEST is used in conjunction with the TEST MODE controls for program debugging and troubleshooting.
	LAMP TEST	LAMP TEST position lights indicators on the front panels as follows: SYSTEM CONTROL PANEL-MEMORY DATA (24 lamps), MEMORY PARITY ERROR, MEMORY PARITY ERROR DISPLAY, PROGRAM ENTRY-ENTRY, MODE SELECT-TEST, SYSTEM RUN, SYSTEM HALT; TEST CONTROL panel-MEMORY TEST ERROR, MEMORY TEST LOAD.
		An internal system reset pulse is generated each time the MODE SELECT switch position is changed.
TEST indicator		Lights red when the MODE SELECT switch is in the TEST position.
MANUAL ENTRY		
WRITE pushbutton	Momentary	Used to manually enter the data selected on the MEMORY DATA switches into the address selected on the MEMORY ADDRESS thumbwheels.
CLEAR pushbutton	Momentary	Used to clear the MEMORY DATA and MEMORY ADDRESS display registers to all 0's.
READ pushbutton	Momentary	Used on the MEMORY DATA switches to display the contents of a memory location selected on the MEMORY ADDRESS thumbwheels.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator System Control Panel (cont)		
SYSTEM		
RUN PBI	Momentary	Used to place the simulator into operation in the dump, sim, and test modes. Lights green when the simulator is operating.
HALT PBI	Momentary	Used to stop simulator operation in the dump, sim, and test modes by inhibiting the internal master clock. Lights red when the master clock is inhibited.
RESET switch	Momentary	Clears all necessary simulator logic circuits.
MEMORY ADDRESS		
Indicators		Octal indicators used to display all memory locations accessed in the dump and test modes; display address of detected memory parity errors; display addresses selected for reading or writing in memory.
Thumbwheel switches (4)	0 - 7	Octal coded thumbwheels used to select addresses for manual reading or writing in memory; also used to locally select the start address for the sim and dump modes.
Simulator Analog Control Panel		
BIT RATE thumbwheel switches	0 - 9	Used to manually select the three significant digits of bit rate.
FINE FREQ control		Vernier bit rate control. Varies the selected bit rate (manual or program) a minimum of ±5 percent.
Selector switch		Selects programmed bit rate, multiplier for manually selected bit rate, or external bit rate clock.
	PROGRAM	Selects bit rate programmed in format instructions 1 and 2.
	1 - 100K	Selects multiplier for the digits selected on the thumbwheels.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Analog Control Panel (cont)		
Selector switch (cont)	EXT	External clock connected to J11. Clock signal ±15 V max; transitions must cross 0 and +5 V. Simulated data bit rate is one-fourth that of the external clock frequency.
CODE TYPE		
SØ, NRZL, NRZM, NRZS, RZ, BIØM, BIØS indicators		Indicate the code type of the simulated data, whether selected manually or by the program.
Selector switches	PROGRAM SØ NRZL NRZM NRZS RZ BIØM BIØS	Used to manually select one of the seven PCM code types or select the code type programmed in format instruction 4.
D/B S/N RATIO		
∞, 16, 8, 4, 2, 1, 0 indicators		Indicate the signal-to-noise ratio of the simulated data, regardless of whether it is selected manually or by the program. Signal-to-noise ratio (in dB) is the sum of the numerical value of the lighted indicators (1 through 31) or will be 0 or ∞. If ∞ indicator is lit, disregard all others.
Selector switch	0, 2, 4, 6, 8, 10, 12, 14, 16, PROGRAM	Programmed noise or manually selected noise.
CALIBRATE switch	SIGNAL OFF NOISE	Removes noise from data output. Adds signal and selected noise. Noise output only.
OUTPUT		
AMPLITUDE control		Varies the simulated PCM signal output over the range of 0 to 20 Vpp. (See note).

Note

The maximum composite signal levels are ±10 V including noise and offset. For example, if the signal is offset +5 V, the maximum signal amplitude that is symmetrical about the offset baseline is 10 Vpp.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Analog Control Panel (cont)		
OFFSET control		Shifts the centerline of the simulated PCM signal positive and negative 5 V with respect to ground. At 0 position,the PCM signal is symmetrical about ground.
CODE POLARITY switch	NORMAL INVERT	Controls the polarity of the PCM data output.
BLANKING		This group of controls is primarily used to blank the PCM data output to simulated loss of data. During the blanking period,the data content of the composite output is clamped to 0-volt level.
REFERENCE ADDRESS thumbwheels (4)	0 - 7	Used to select memory addresses as follows: In the simulator sim mode,the thumbwheels are used to select the program address at which data blanking is to start (AUTO/OFF/ MANUAL switch in AUTO). In the simulator dump mode,the thumbwheels are used to select the last address from which data is to be dumped to an external device such as a computer. In the simulator test mode,the thumbwheels are used to stop execution of the program at the selected address when the TEST MODE selector switch is in REF ADDR STOP.
AUTO/OFF/MANUAL switch		Three-position switch used to control the blanking mode.
	AUTO	In AUTO position, blanking begins at the program instruction selected on the REFERENCE ADDRESS thumbwheels and blanks the number of PCM bits selected on the BITS BLANKED thumbwheels.
	OFF	In OFF position the blanking function is disabled.
	MANUAL	In MANUAL position (momentary) the data is blanked only while the switch is held in MANUAL.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Analog Control Panel (cont)		
BLANKING (cont)		
BITS BLANKED thumbwheels (3)	0 - 9	Selects the number (decimal) of consecutive PCM bits to be blanked.
TEST MODE selector switch		Selects the test operation to be performed when the simulator is placed in the test mode (MODE SELECT switch to TEST).
	MEM TEST	Used during automatic memory test using the MEMORY TEST controls.
	SINGLE CYCLE	Used to execute the program one memory cycle at a time each time the SYSTEM RUN pushbutton is pressed.
	SINGLE BIT	Used to execute the program one simulated PCM bit at a time each time the BIT/SYL STEP pushbutton is pressed.
	SINGLE SYL	Used to execute the program one simulated PCM syllable at a time each time the BIT/SYL STEP pushbutton is pressed.
	REF ADDR STOP	Used to execute the program and stop at the memory address selected on the REFERENCE ADDRESS thumbwheels. Each time the BIT/SYL STEP pushbutton is pressed,the program proceeds to the next selected REFERENCE ADDRESS.
BIT/SYL STEP pushbutton	Momentary	Used to execute test modes as described above.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Test Control Panel (cont)		
MEMORY TEST		
PATTERN switch		Selects the memory test pattern.
	0	0 position selects 0's to be loaded into all bits of all memory addresses.
	1	1 position selects 1's to be loaded into all bits of all memory addresses.
	WP	WP position selects the "worst pattern" memory test pattern (data pattern loaded in memory which generates maximum noise and bit cross-talk).
	WPC	WPC position selects the complement of the "worst pattern" test pattern.
ERROR indicator		Lights red when an error is detected when operating the simulator in the memory test mode.
LOAD PBI	Momentary	Pressed to load the test pattern selected on the PATTERN switch To load a pattern, the LOAD PBI is pressed and then the START PBI is pressed.
START PBI	Momentary	Used to start simulator operation in the memory test mode.
STOP/STEP pushbutton	STOP STEP	Used to stop automatic loading or reading of the selected test pattern. After having been pressed once to stop loading or reading, advances the memory one address each additional time pressed.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Test Control Panel (cont)		
COMPARATOR		Group of controls used to compare two serial data streams for the purpose of performing bit error rate measurements. An external frequency counter is required for this purpose.
INPUT switch	INT EXT	Used to select two signals for comparison. EXT position selects two externally-supplied serial data signals (EXT DATA 1 & EXT DATA 2) and external bit rate clock signals. The two external clock signals must be bit rate synchronous to EXT DATA 1 and have the same characteristics as the simulator A & B clocks. INT position selects external serial data (BIT SYNC) and the internally-generated simulated PCM for comparison.
DELAY SELECT switches	0, 1, 2, 3, 4, 5, 0, 1/4, 1/2, 3/4	Used to delay one serial data signal to align the two so that a bit-by-bit comparison may be performed. Delays are selectable in one-fourth bit increments from 0 to 5-3/4 bit periods.
COUNTER INPUTS switches		Select the inputs for an external dual-channel frequency counter.
CHANNEL A switch		Selects the input to channel A of the external counter as follows:
	EXT	Selects front-panel connector CHAN A EXT INPUT.
	F CTR	Selects the F counter reset pulse.
	MEM CYCLES	Selects the internal +CLK IV pulse which is true once each time the memory is cycled.
	BIT RATE	Selects the internally-generated bit rate A clock pulse.
	SYL RATE	Selects the last bit/syllable pulse (+SYL LB).

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Simulator Test Control Panel (cont)		
COUNTER INPUTS switches (cont)		
CHANNEL A switch (cont)	DATA	Selects the +DAT ONE signal which is true each time a binary 1 is generated in the simulated data output.
	DATA TRANS	Selects the serial simulated data after conversion to the selected PCM code type for purposes of counting the bit transitions.
	COMP ERROR	Selects the output of the comparator for purposes of counting the number of noncompare bits.
CHANNEL B switch		Selects the input to channel B of the external counter as follows:
	EXT	Selects from panel connector CHAN B EXT INPUT.
	BIT RATE	Selects the internally-generated bit rate A clock pulse.
	F CTR	Selects the F counter reset pulse.
	CTR 1	Selects program counter 1 reset pulse.
	CTR 2	Selects program counter 2 reset pulse.
	CTR 3	Selects program counter 3 reset pulse.
	CTR 4	Selects program counter 4 reset pulse.
	CTR 5	Selects program counter 5 reset pulse.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator Memory Display Panel		
MEMORY DISPLAY PBI's (36)	Momentary	Used to display the binary contents of specific memory addresses and to manually load data into selected memory addresses. When operating in the system dump and test modes, each memory address accessed is displayed. When a manual read operation is performed, the contents of the memory location selected on the MEMORY ADDRESS thumbwheels are displayed. When manually writing data in memory, the content of the memory word is selected by pressing the pushbuttons; each time a pushbutton is pressed, the associated bit complements. A lighted pushbutton indicates a 1; extinguished indicates 0. During execution of a program, the contents of memory words which contain parity errors are displayed if the MEMORY PARITY ERROR DISPLAY PBI is lit.
PROGRAM NO. indicators		Display the number of the data processing program currently being executed.
▼ START ADDRESS switches (octal)	0000-7777	Used to select the first address of a data processing program to be executed or the first address of memory to be dumped to the paper tape punch.
MEMORY ADDRESS indicators (octal)		Used to display all memory addresses accessed in the dump and test modes; displays addresses of detected memory word parity errors if the MEMORY PARITY ERROR DISPLAY PBI is lit; displays addresses selected for manually reading and writing in memory.

▼ Specified in NOSP.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator System Control Panel		
DATA SOURCE switch	BIT SYNC SIM AUX	Selects data for group synchronizer.
START SOURCE switch - indicator	LOCAL	System may be started from control panel.
	REMOTE	System may be started by the computer.
MODE SELECT switch	PROG PUNCH	Sets up system for dumping memory to the paper tape punch.
	DECOM	Sets up system for executing a PCM data processing program.
	TEST	Sets up system for performing testing functions and for executing test programs.
	LAMP TEST	Lights all incandescent indicators on the following: decommutator control assy, group sync/self test assy, event store relays assy, calibration panel.
MODE SELECT		
DECOM indicator		Lights green to indicate the MODE SELECT switch is in the DECOM position.
TEST indicator		Lights red to indicate that the MODE SELECT switch is in the TEST position.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator System Control Panel (cont)		
PROGRAM ENTRY switch		Selects the method of loading programs into the memory.
	MAN	Enables the MANUAL ENTRY controls.
	TAPE	Enables the paper tape reader input channel.
	CMPTR	Enables the external computer input channel.
PROGRAM ENTRY		
ENTRY indicator		Lights yellow to indicate that the paper tape reader or the external computer is loading the decommutator memory.
TAPE LOAD PBI	Momentary	Starts the paper tape reader for loading either the decommutator or the simulator memory. Lights when the paper tape reader starts.
ERROR STOP PBI	STOP OFF	When pressed to the lit (white) position, will inhibit further loading of either the simulator or the decommutator memory if a memory parity error is detected during the check cycle that follows writing of an instruction in memory.
RELATIVE ADDRESS PBI	ADD OFF	Used when loading and dumping programs in the decommutator memory. When pressed to the lit (yellow) position, enables relative addressing for decommutator programs. Relative addressing causes the octal number selected on the MEMORY ADDRESS thumbwheels to be added to the input memory addresses and to the address fields of program instructions.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator System Control Panel (cont)		
MANUAL ENTRY		
WRITE PBI	Momentary	Lights when the PROGRAM ENTRY selector switch is in the MAN position. Momentary switch initiates a manual write operation to load the memory word selected on the MEMORY DISPLAY PBI into the address selected on the MEMORY ADDRESS thumbwheels.
READ PBI	Momentary	Lights when the PROGRAM ENTRY selector switch is in the MAN position. Momentary switch initiates a manual read operation to display the contents of the address selected on the MEMORY ADDRESS thumbwheels or the MEMORY DISPLAY PBI's.
CLEAR PBI	Momentary	Lights when the PROGRAM ENTRY selector switch is in the MAN position. Momentary switch clears the MEMORY DISPLAY and MEMORY ADDRESS display registers to all 0's. Does not affect the memory contents.
SYSTEM		
RUN PBI	Momentary	Used to initiate local operation of the decommutator in any of the three primary modes (prog punch, decom, or test). Lights green when the decommutator is in a "run" condition; e.g., the master clock is enabled.
HALT PBI	Momentary	Used to stop operation of the decommutator. When pressed, inhibits the master clock. Lights red when the master clock is inhibited.
RESET switch	Momentary	Initiates a master system clear to reset control logic, counters, registers, etc. to return the decommutator to an initial state.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator System Control Panel (cont)		
MEMORY ADDRESS switches (octal)	0000-7777	Used to select memory addresses for manual read and write operations; also selects the reference stop address used during self-test operation and dump mode operation.
MEMORY PARITY		
ERROR PBI	Momentary	Lights red when a parity error is detected in a memory word. Clears the parity error display and control logic when pressed.
ERROR DISPLAY PBI	ON OFF	When pressed to the lit position, enables display of a memory word containing a parity error (and its address) on the memory display panel.
Decommutator Group Sync Display Panel		
SYNC STATUS		This group of controls and indicators displays the status of the bit synchronizer (PCM signal conditioner) and the group synchronizers. A reset-to-search switch is provided for each group synchronizer.
LOCK indicators (6)	BIT LOCK WORD FRAME SF1 SF2 SF3	BIT LOCK lights green when the PCM signal conditioner has required bit rate synchronization. WORD, FRAME, SF1, SF2, and SF3 light green when the respective group synchronizers have acquired sync (mode III).
CHECK indicators (6)	BIT CHECK WORD FRAME SF1 SF2 SF3	BIT CHECK lights yellow when the PCM signal conditioner is not in bit rate synchronization. WORD, FRAME, SF1, SF2, and SF3 light yellow when the respective group synchronizers have detected a probable sync location and are checking the pattern (mode II).
SEARCH/RESET PBI's (5)	Momentary	Light red when the respective group synchronizers are in the search mode (mode I). Returns the respective synchronizer to search mode when pressed.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator Group Sync Display Panel (cont)		
DATA PARITY ERRORS		
RESET switch	Momentary	Used to reset the DATA PARITY ERROR display to zero.
SAMPLE RATE switch	FRAME SF1 SF2 SF3	Selects the PCM format interval over which PCM data word parity errors are counted; e.g., errors/frame or errors/subframe 1, 2, 3.
FRAME SYNC ERRORS		
RESET switch	Momentary	Used to reset the FRAME SYNC ERROR display to zero.
SAMPLE RATE switch	FRAME SF1 SF2 SF3	When the SELECT PBI is not lit, the switch selects the PCM format interval (FRAME, SF1, SF2, or SF3) over which frame sync pattern errors are counted and displayed. When the SELECT PBI is lit, the number of bit errors per selected pattern are counted and displayed. For example, if the SELECT PBI is lit and SF1 is selected on the SAMPLE RATE switch, the number of bit errors per subframe 1 sync pattern is displayed.
SELECT PBI	Frame Pattern	Selects the mode of frame sync error display. When extinguished, the number of frame sync bit errors detected over the time base selected by the SAMPLE RATE switch is displayed. When in the lighted (white) position, the number of sync pattern bit errors per pattern selected on the SAMPLE RATE switch is displayed.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator Peripheral Control Panel		
EVENT RELAYS PBI	INHIBIT OFF	When pressed to the lit position (red), inhibits the event stores relays in units 4010 (rack 4) and 5010 (rack 5); does not inhibit the event stores indicators.
▼ SYNC VALIDITY PBI WORD FRAME SF 1 SF 2 SF 3	 ON/OFF ON/OFF ON/OFF ON/OFF ON/OFF	Used to determine what the synchronization status must be to pass data through the system outputs. If switches are not lighted, the frame synchronizer must be in lock and the other synchronizers must not be in search before the data is considered valid. If a switch is lighted, that synchronizer's status is manually satisfied. Specified in NOSP when computer transfer is required.
COMPUTER OVERRIDE PBI	ON OFF	When lit, overrides the sync validity requirements for the computer buffers; e.g., the computer buffer ignores the system status.
BUFFER OVERFLOW PBI	Momentary	Lights red to indicate that an overflow (resulting from a programming error) has occurred in computer buffer 2 while serially buffering data. An overflow exists when the counter which supplies addresses for unloading data from memory overtakes the counter which supplies the load addresses. The error indication is cleared by pressing the PBI.
PRINTER switch	PCM DATA COUNTER	Selects the data source into the printer; either decommutated PCM data or the BCD output of the EPUT counter.
PRINTER ENABLE PBI	ON OFF	When pressed to the lighted (white) position, the printer is enabled to print data on command.
PUNCH switch	PCM DATA COUNTER	Selects the data source into the paper tape punch; either decommutated PCM data or the contents of memory during dump mode operation.

▼ Specified in NOSP.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Decommutator Peripheral Control Panel (cont)		
PUNCH		
LEADER PB	Momentary	When pressed,advances the paper tape punch and causes leader sprocket holes to be punched.
STOP CHAR PB	Momentary	When pressed,enters a stop character on the paper tape.
ENABLE PBI	ON OFF	When pressed to the lighted (white) position, the paper tape punch is enabled to punch data on command.
STATUS MONITOR		These controls are used by the operator to notify external stations of the ready/not ready status of the system.
REQD indicator		Lights yellow when the external station requires the system to be in a ready-for-use status.
READY PBI	ON OFF	If the REQD indicator is lit, the operator may press READY to indicate that the system is ready for use. When pressed, READY lights green and remains lit after the REQD extinguishes. If REQD is extinguished, the operator may indicate not ready by pressing READY so that it extinguishes.
Binary Display Panel		
BINARY DISPLAY indicators		Provide binary display of a decommutated PCM data word selected on the DATA TAG thumbwheel switches.
DATA TAG switches (4)	0000-7777	Select the data tag associated with the PCM word desired for display.
RESET PB	Momentary	Used to reset the binary display to all 0's.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Event Stores 1 through 64		
LAMP TEST PB	Momentary	Used to test all of the indicators for event stores 1 through 64. When pushbutton is pressed, the indicators light. The associated relays are inhibited during LAMP TEST.
EVENT STORES (1 through 64 indicators)		Light when the associated event store contains a high level in its storage register. When any of the indicators are lit,the associated event store relay is in the energized state. All of the indicators light during LAMP TEST operation.
Event Stores 65 through 127		
LAMP TEST PB	Momentary	Used to test all of the indicators for event stores 65 through 127. When the pushbutton is pressed,the indicators light. The associated relays are inhibited during LAMP TEST.
EVENT STORES (65 through 127 indicators)		Light when the associated event store contains a high level in its storage register. When any of the indicators are lit,the associated event store relay is in the energized state. In addition to the normal operation,all the indicators will light during LAMP TEST.
Calibration Panel		
CALIBRATE MODE PBI	Momentary	Enables D-A calibration for both the channel select D-A converters (20) and the program controlled D-A converters (32). Indicator lights red when CALIBRATE MODE has been selected.
100%/0% calibration percentage selection switch	100%	Used to select the percentage of D-A calibration. Minimum 0 volt equals 0 percent,maximum +10 volt equals 100 percent.
LOAD pushbutton	Momentary	Loads all DAC's (20 channel select and 32 program controlled) with zero or full-scale input as selected by the percentage switch. The CALIBRATE MODE PBI must be in the CALIBRATE MODE position to load the DAC's by pressing the LOAD pushbutton.

Table 4-17. Dynatronics PCM-DHS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Channel Select Panel		
CHANNEL SELECT NO 1 display		Nixie readouts (3 digits) used to display the OCTAL or DECIMAL equivalent of the collected PCM word for the appropriate CHANNEL SELECT. Maximum OCTAL reading is 777 and the maximum DECIMAL reading is 512. The type of numerical readout is determined by the position of the OCTAL/DEC switch.
OCTAL/DEC switch	OCTAL DEC	Selects the type of readout for the Nixie display. The numerical equivalent of the PCM data word can be displayed in either octal or decimal form. OCTAL is selected by the up position and DEC (decimal) is selected by the down position.
RESET PB	Momentary	Used to reset the Nixie display to an all-0's readout. The RESET push-button will reset only the Nixie display for the CHANNEL SELECT where the reset switch is located.
DATA TAG thumbwheel switches	$0000\text{-}3777_8$	Used to select the data tag of the PCM word to be displayed. The maximum DATA TAG identifier is 3777_8 and the switches can be changed at any time independent of system operation. When a CHANNEL SELECT is not in use, it is recommended that the DATA TAG switches and the SYLLABLE START/STOP switches be placed to all 0's.
SYLLABLE START/ STOP thumbwheel switches	00-99	Used to select the portion (syllable) of a PCM word to be displayed on the CHANNEL SELECT indicators. The START switches select the first bit in the PCM word with respect to serial time, and the STOP switches select last bit in the syllable. The syllable length selected can consist of any sequential bits in the PCM word from 1 through 9 bits. If syllables from the same PCM data word are to be displayed on two different channel selectors, the two syllables may not overlap.

4.2.3.5 Frame Synchronizers

a. Model 401 PCM Frame Synchronizer. The Model 401 frame synchronizer accepts serial PCM data and clock signals; monitors the input signal for errors; and, if the data is acceptable, converts it to parallel form for computer entry or front-panel display. A throughput mode is available in which the data is passed directly through the frame synchronizer to the computer. The Model 401 also has the capability to accept and convert quantized data. The unit may be controlled manually or programmed remotely by a computer. See figure 4-7 for an input/output diagram. Refer to table 4-18 for characteristics and table 4-19 for front- and rear-panel control functions.

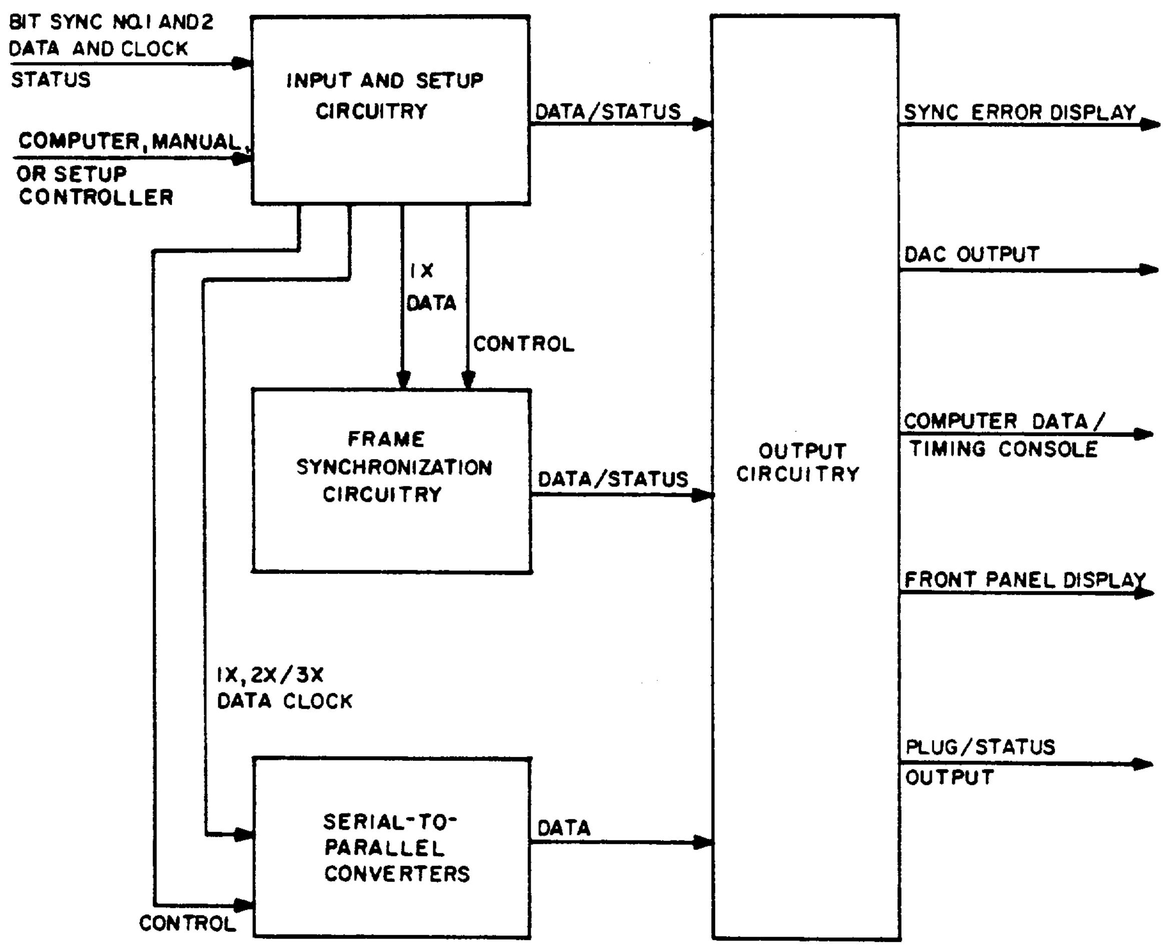


Figure 4-7. Model 401 PCM Frame Synchronizer Diagram

Table 4-18. Model 401 PCM Frame Synchronizer Characteristics

Parameter	Characteristics
<u>Synchronizer</u>	
Bit Rate	Up to 1 Mb/sec (or quantized at 2 or 3 times normal rate).
Synchronizers	Main frame only.
Modes	Search, Check, Lock.
Word Length	4 to 16 bits.
Programs	One (entered either manually or from remote setup controller).
<u>System Outputs</u>	
Parallel word output	Up to 16 bits (programmable).
Logic Levels	642B Interface: Logic "1" = 0.25 ±0.25 V. Logic "0" = 3.75 ±0.75 V. Network Interface: Logic "1" = +4.25 ±1.75 V. Logic "0" = 0.0 ± 0.5 V.
Digital-to-analog Converter	One
Range	0.0 to 5.0 V.

Table 4-19. Model 401/403 PCM Frame Synchronizer Front- and Rear-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Two position vertical throw toggle switch. In ON position,applies ac power to the unit.
RESET PB	Momentary	Actuation causes the reset of the manually selected function and instruction bits in the manual register.
FUNCTION PBI (4)	8 thru 11	Pressing of a PBI causes a bit to be set in the manual register and the PBI to light white. These four PBI's select one of 15 instruction registers.
INSTRUCTION PBI (8)	0 thru 7	Pressing of a PB causes a bit to be set in the manual register and the PBI to light white.
ENTER PB	Momentary	Pressing of the PBI causes the selected instruction register to be updated with the contents of the manual register (8 instruction bits only).
START BIT thumbwheel switches (4) (401)	0000 thru 9999	Selects the first bit of 16 consecutive bits which are displayed on the DATA REGISTER display.
FRAME RESET PB	Momentary	Resets frame synchronizer to the search mode.
LOCAL/REMOTE switch (401)	LOCAL REMOTE	Selects source of setup instructions. LOCAL position enables front-panel switches. REMOTE position enables computer bus for external loading.
SETUP/DATA switch (401)	SETUP DATA	Selects data to be displayed on front-panel indicators (data register). SETUP enables the instruction registers to be displayed. DATA enables the PCM data to be displayed.
DISPLAY DATA switch (401)	1X 2X/3X	Selects the type of data to be displayed when switch S4 is in the DATA position. 1X enables normal frame sync data to be displayed. 2X/3X enables quantized data to be displayed.

Table 4-19. Model 401/403 PCM Frame Synchronizer Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
SYNC ERRORS PB	RESET	Resets the frame sync error display to zero.
BIPOLAR POS/NEG switches (rear panel)	BIPOLAR POS/NEG	Selects the proper level shifting circuitry for the incoming data and clock. The BIPOLAR position allows bipolar signals to be accepted. The POS/NEG position allows positive or negative signals to be accepted.
DISPLAY WORD (403)	000-999	Three decimal display thumbwheel switches that permit selection of any word of data in a frame for display on the data register.
DATA/REMOTE switch (403)	DATA SET-UP REMOTE	3-position rotary switch. DATA and SET-UP permit manual programming. DATA causes selected word to be displayed. SET-UP causes instruction register to be displayed. REMOTE permits programming by computer for external loading.

b. Monitor 403 PCM Frame Synchronizer. The Monitor 403 frame synchronizer functions as an interface between the serial output of a PCM bit synchronizer and the parallel input to a computer. The frame synchronizer searches for and locates a frame sync pattern in an incoming data stream and performs synchronized serial-to-parallel conversion for parallel output of the data along with appropriate status conditions. The frame synchronizer may be programmed locally or remotely. The unit has front-panel display capability of one 16-bit word. See figure 4-8 for a block diagram of the Monitor 403 frame synchronizer. Refer to table 4-19 for front-panel control functions and to table 4-20 for equipment characteristics.

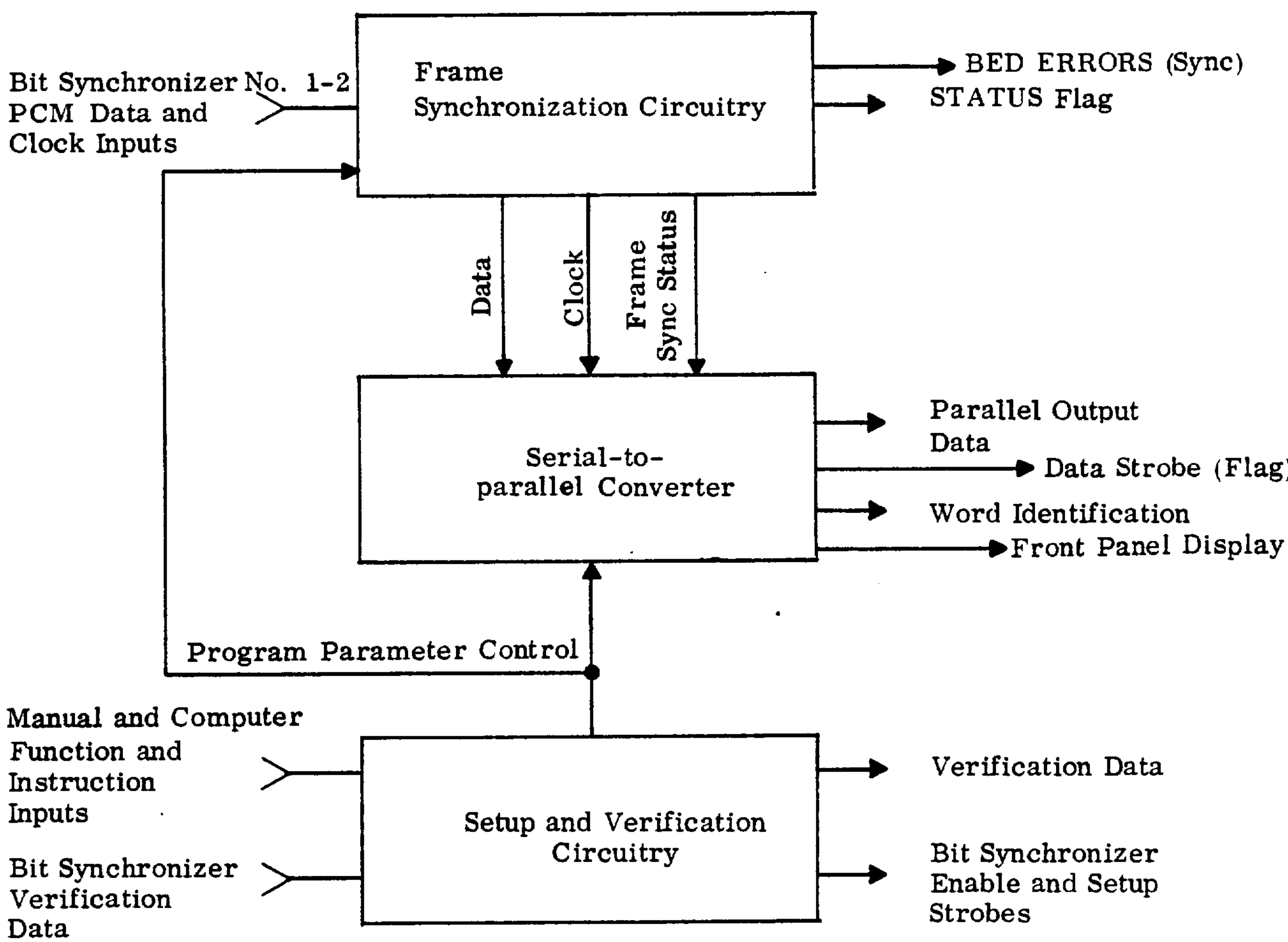


Figure 4-8. Monitor 403 PCM Frame Synchronizer Block Diagram

Table 4-20. Model 403 PCM Frame Synchronizer Characteristics

Parameter	Characteristic
Synchronizer	
Bit Rate	Up to 5 Mb/sec (at normal rate or quantized at 2 or 3 times normal rate).
Synchronizers	Main frame only.
Modes	Search, check, lock.
Word Length	4 to 16 bits.
Programs	One (entered either manually or from remote setup controller).
System Outputs	
Parallel word output	4 to 16 bits.
Logic Levels	Logic 1 = $+4.0 \pm 1.0$ V. Logic 0 = 0.0 ± 0.5 V.

4.2.3.6 Monitor 440 PCM Format Synchronizer. The Monitor 440 format synchronizer is designed to accept serial PCM data and clock signals. The format synchronizer searches for and locates a frame synchronization pattern in an incoming data stream, and performs synchronized serial-to-parallel conversion for parallel output of the data, along with appropriate status conditions. Total format synchronization is achieved through the inclusion of the optional subframe synchronizer. The format synchronizer is programmed locally, remotely, or from the internally-stored Programmable Read-only Memory (PROM) program formats. The unit has front-panel display capability of one 16-bit word. See figure 4-8A for a block diagram of the format synchronizer. Refer to table 4-20A for equipment characteristics, and table 4-20B for front-panel control functions.

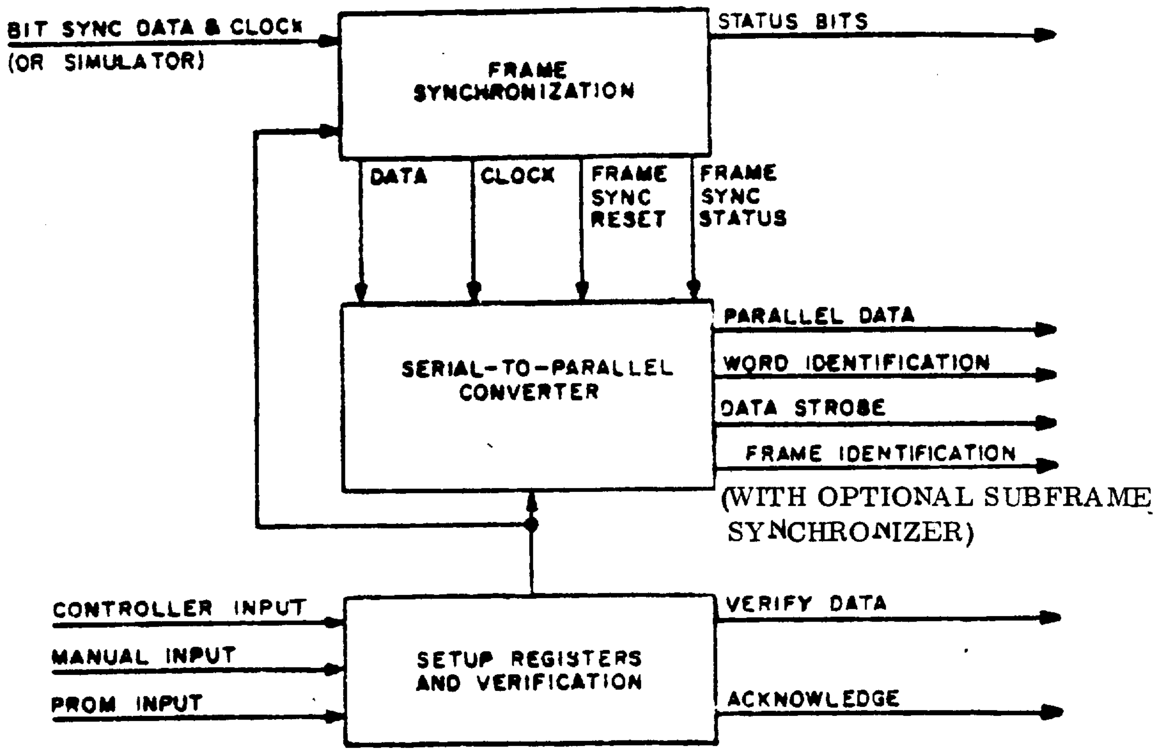


Figure 4-8A. Model 440 PCM Format Synchronizer Block Diagram

Table 4-20A. Model 440 PCM Format Synchronizer Characteristics

Parameter	Characteristics
<u>Synchronizer</u>	
Bit Rate	Up to 10 Mb/sec.
Synchronizers	Main frame and subframe (with optional subframe synchronizer incorporated).
Modes	Search, check, lock.
Word Length	1 to 16 bits.
Programs	One (entered either manually or from remote setup controller), or one of four internally-stored PROM program formats.

Table 4-20A. Model 440 PCM Format Synchronizer Characteristics (cont)

Parameter	Characteristics
System Outputs	
Parallel Word Output	4 to 16 bits.
Logic Levels	Logic 1 = +3.75 $\pm$1.25V, Logic 0 = 0.0 $\pm$0.5V.

Table 4-20B. Model 440 PCM Format Synchronizer Front- and Rear-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON/OFF	Applies ac power to unit.
RESET pushbutton	Momentary	Resets all FUNCTION and INSTRUCTION data bits to zero.
FUNCTION pushbutton indicator	8 thru 11	Four momentary-contact pushbuttons and indicators. Actuation of switches selects instruction register; indicators display binary address of register selected. Effective only in frame or subframe mode.
INSTRUCTION pushbutton indicator	0 thru 7	Eight momentary-contact pushbuttons and indicators. Actuation of switches sets up instruction data for manually entering into selected instruction register; indicators display contents of selected instruction register. Effective only in frame or subframe mode.
ENTER pushbutton	Momentary	Actuation of the switch causes the selected instruction register to be updated with information supplied manually via the INSTRUCTION pushbutton/indicators in frame or subframe mode.

Table 4-20B. Model 440 PCM Format Synchronizer Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
READ pushbutton	Momentary	Actuation of the switch causes the contents of the selected instruction register to be displayed by INSTRUCTION pushbutton/indicators in frame or subframe mode.
FRAME switch	IN/OUT	This switch determines whether a selected data word is displayed as it occurs during every frame (OUT position) or only during a particular frame (IN position). Switch must be set to OUT if subframe synchronizer is not incorporated.
FRAME SELECT switch	000 thru 999	Selects a particular frame in which a data word is selected for display when the optional subframe synchronizer is incorporated (capable of a 0 to 511 maximum frame count).
WORD SELECT switch	000 thru 999	Selects any data word for display by the data register.
▼ SETUP switch	FRAME/SFR/PROM/REMOTE	Selects format synchronizer programming mode.
LAMP TEST pushbutton	Momentary	Lights front-panel indicators to verify their condition.
PROM:		
▼ FORMAT switch	0 thru 3	Permits selection of any of the four internally-stored program formats in the prom setup mode.
INITIATE pushbutton	Momentary	Loads the instruction registers with the selected format when the unit is in the prom setup mode.
LOCK RESET pushbutton	Momentary	Resets frame and subframe synchronizers from lock to search mode.

▼ Specified in NOSP.

Table 4-20B. Model 440 PCM Format Synchronizer Front- and Rear-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
UNIT ADDRESS SWITCHES (rear panel)	2, 4, 8	Permit assigning the three Most Significant Bits (MSB) of the unique 4-bit binary unit address to the format synchronizer. The fourth LSB addresses either the frame synchronization function (0) or the subframe synchronization function (1) of the unit.

4.2.3.7 Setup Controller

a. The Setup Controller (SUC) is a format storage and setup loader for the programmable system equipment. Two methods of loading formats into the SUC are provided: manually at front-panel switches or remotely via paper tape reader inputs. An input mode switch on the front panel selects the type of format loading. Five output modes are also selectable via a front-panel OUTPUT mode switch. A simplified block diagram of the SUC is shown in figure 4-9 showing the system inputs and outputs of the unit.

b. When loading the memory, up to 16 separate formats may be stored. Each format is effectively a table in memory containing multiple instructions as required. Normally, the first 16 locations (0-15) of the memory contain the list of format numbers (0-15). Stored with the format number in a memory location is an address which is the starting address of the corresponding format table. The starting address location of a table and successive locations contain instructions of the format table. The last location of a format table should contain an all 0's pattern indicating the end of the table.

c. The method of outputting a format is either locally at a front-panel INITIATE switch or remotely via a remote initiate command. When a local output mode is selected, the number of the format is selected at the front-panel FORMAT select switches. The format table output is then initiated by setting the INITIATE/CLEAR switch to INITIATE. A complete list of instructions (one at a time) from the format table is then output. As each instruction is output, a strobe is also provided. Before a subsequent instruction can be output, the addressed programmable unit at the output must respond by supplying an acknowledge to the SUC.

d. Five separate setup busses are included at the SUC output. The instructions output from the SUC are supplied on all busses simultaneously. A common strobe line (INSTRB) is also supplied. Each of the five busses is a 16-line parallel output. The instructions output on the busses are thus 16-bit words which are supplied as setup commands to the system equipment connected to the busses.

e. When a remote output mode is selected, either of two types of instructions may be output. The first of these is a remote initiate mode in which the instructions are derived from the SUC memory as in a local initiate mode. A remote initiate command is supplied as well as the format number to be output. The operation from this point is identical to that of the local initiate mode. The second remote mode is a remote loading mode in which the instructions to be output are derived directly from the Remote Control and Monitoring Unit (RCMU). The SUC is a passive unit in this mode and no memory communication occurs.

f. Three additional local output modes are also provided; a step mode, a 0 mode, and a 1 mode. In the step mode, the format number to be output is selected the same as the local mode described previously. However, the instructions from the format table are output one at a time. Outputting of each instruction is initiated by setting the INITIATE/CLEAR switch to INITIATE. The 0 and 1 test modes are identical to a local output mode except that the least-significant bits of each instruction output are clamped to either logic 0 levels or logic 1 levels.

g. Table 4-21 lists characteristics, and table 4-22 lists front-panel controls.

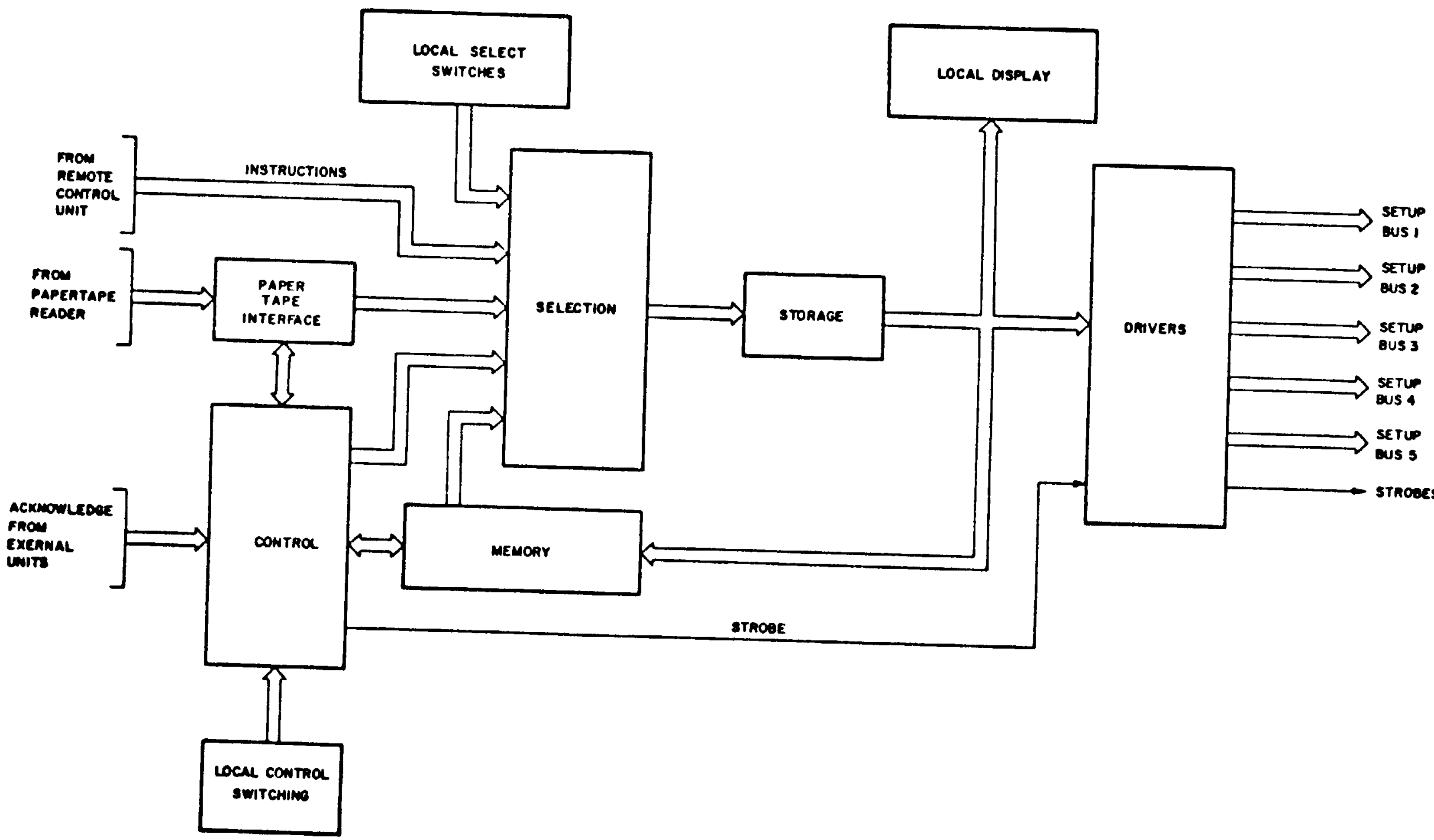


Figure 4-9. Setup Controller Simplified Block Diagram

Table 4-21. Setup Controller Characteristics

Parameter	Characteristics
Input	Paper tape reader or manual entry.
Logic Levels	Logic 1 = +3 to 5 V. Logic 0 = 0 to +0.45 V.
Memory	2048 words (each word 16 bits).
Output Modes	Two test modes. One step mode. One local initiate mode. One remote mode.
Output	16-bit parallel output word with strobe.

Table 4-22. Setup Controller Front-panel Controls, Indicators, and Functions

Control/Indicator	Position	Purpose
FORMAT display (Two-digit LED)		Displays the selected format number (0-15) from memory.
FORMAT select thumbwheel switch		Used to select the format number (0-15) to be output from memory.
FORMAT mode (7-position rotary switch)		Used to select the operating mode for either entering instructions into the SUC or outputting instructions from the unit. Two INPUT positions and five OUTPUT positions are provided. The INPUT positions are described as follows:
INPUT	LOCAL	The SUC memory is programmed locally by front-panel switches in this mode.
	TAPE	The SUC memory is programmed remotely by a paper tape reader in this mode.
OUTPUT		The OUTPUT positions are described as follows:
	1	This is a test output mode position in which a complete format will be output. However, the data bits (eight least-significant bits) of all instructions are set to logic 1's. Remaining bits of the instructions (eight most-significant bits) are output from memory as programmed.
	0	This is also a test mode position. The unit output is the same as that described for the 1 output position except all logic 0's will be output for the data bits (0-7).

Table 4-22. Setup Controller Front-panel Controls, Indicators, and Functions (cont)

Control/Indicator	Position	Purpose
FORMAT mode (cont)		
OUTPUT (cont)	STEP	This is a manual output mode position. Instructions from memory will be output one at a time using the INITIATE position of the INITIATE/CLEAR switch.
	LOCAL	This is a manual output mode in which the format to be output is selected and initiated by front-panel switches.
	RMT	In this position, the instructions to be output are supplied by a remote source or a memory output is initiated by a remote command.
INITIATE/CLEAR toggle switch	Momentary	This switch has two momentary positions (up and down) and a center off position. The INITIATE position is used to start a paper tape input mode or to start an output mode (except for an RMT output mode). For a tape input mode, the switch is set to INITIATE then released. The tape reader supplies the desired format information to the memory and is stored. For a 1 or 0 test output mode, the switch is set to INITIATE and released. A complete format will be output with all address information included but data bits fixed at logic 1's and 0's. For a local output mode, the switch is set to INITIATE and released. The memory data in the selected format will be output in sequence. In a STEP OUTPUT mode, the switch is set to INITIATE each time an instruction is to be output. Only one instruction will be output at a time. The CLEAR position is used to reset the circuits of the SUC. Any mode may be reset to the initial power-on condition by setting the switch to CLEAR.

Table 4-22. Setup Controller Front-panel Controls, Indicators, and Functions (cont)

Control/Indicator	Position	Purpose
POWER toggle switch	ON OFF	Used to apply primary ac power to power supplies.
POWER display lamp		Lights when ac power is ON.
DATA LOAD/DISP toggle switch	Momentary	This switch has three positions, momentary up and down and center off. The switch is active only when the FORMAT mode switch is set to LOCAL input.
	DATA LOAD	When the switch is set to DATA LOAD, the data bits set at the MEMORY toggle switches are stored in the data register and are transferred to the memory location specified by the address counter outputs to the memory. Setting the switch again increments the address counter to the next memory address and again loads the data bits set at the MEMORY toggle switches into the data register and then transfers the data bits to the addressed memory location.
	DISP	When the switch is reset to DISP (display), the data bits in the data register are displayed. Resetting the switch a second time (in succession) causes a memory read cycle and the data from the addressed memory location is stored in the data register and displayed. Each time the switch is reset, the address counter is incremented to the next address and the data from the addressed memory location is displayed.
ADD LOAD/DISP toggle switch	Momentary	This switch has three positions identical to the DATA LOAD/DISP switch S2. Operation of the switch is the same as that described for the DATA LOAD/DISP switch except that the address counter is loaded by the MEMORY toggle switches and the address counter outputs are displayed instead of the memory data bits.

Table 4-22. Setup Controller Front-panel Controls, Indicators, and Functions (cont)

Control/Indicator	Position	Purpose
MEMORY toggle switches	Two-position	These 16 switches are used to select address information for the address counter to select data bits for storage in the memory. When an address load function is performed, the address set at the toggle switches is loaded into the address counter. When a data load function is performed, the data bits set at the toggle switches are stored in the memory.
MEMORY display lamps		These lamps display the contents of the data register at all times. The information displayed may be address or data as determined by the display mode selected.

4.2.3.8 DDPS Word Formatter

a. The Digital Data Processing System (DDPS) word formatter is designed to provide an interface link between the MSFTP-2 PCM decommutator, DHS decom, and the 642B computer systems or TDC. The DDPS word formatter accepts parallel data from the decommutators in word lengths ranging from 4 to 16 bits and transforms them through manipulation into 16-bit words. The 16-bit words are then transferred to the 642B computer system or the TDC.

b. Two operational modes are provided by front-panel switch selection or telemetry software. Normal mode, which formats data into 16-bit words, and the throughput mode in which the data is transferred as 16-bit words and routed through the line receiver and line drive subassemblies of the DDPS word formatter. Refer to table 4-23 for characteristics, table 4-24 for nominal switch position settings, and appendix F for MSFTP-2 computer buffer patching instructions. For Dynatronics DHS computer buffer patching, refer to appendix H. The word formatters may be under software control of their respective decommutators (see applicable TESOC).

Table 4-23. DDPS Word Formatter Characteristics

Parameter	Characteristics
<u>Input Interface</u>	
Data	4 to 24 bits/word.
Bit Rate	Up to 1 Mb/sec.
Word Transfer Rate	1 MHz ÷ N where N = the number of bits/word.
Modes	Normal or throughput.
<u>Output Interface</u>	
Data	16 bits/word (normal mode).
Status	10 bits/word.
Interrupts	External Interrupt (EI). Input Data Request (IDR).
Output Logic Levels	
642B Computer	-4.5 ± 1.5 V = Logical 0. 0.0 ± 0.5 V = Logical 1.
TDC	0.0 ± 0.5 V = Logical 0. $+3.75 \pm 1.25$ V = Logical 1.

Table 4-24. DDPS Word Formatter Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
AC POWER switch	ON OFF	DDPS word formatter power.
OVERFLOW PBI		When lit, indicates that the formatter word memory is receiving more formatted words than the computer is accepting. When the overflow condition is corrected, the indicator may be extinguished by momentarily pressing the pushbutton.
RESET pushbutton		Resets the DDPS formatter.
INPUT BITS/WORD thumbwheel adjustable switch		Sets the number of bits per word to coincide with bits-per-word input from the decommutator. The thumbwheel switch assemblies are adjustable between 4 and 24 bits per word and must agree with decommutator input.
LOAD pushbutton		Loads the INPUT BITS/WORD thumbwheel switch setting into memory. This data must be reloaded anytime power is interrupted.
SETUP rotary switch	LOCAL	For LOCAL position, all formatter control inputs are entered from front panel.
	REMOTE	For REMOTE position, all formatter control inputs except POWER, INHIBIT EI/IDR, and IDR/EI RATIO are entered from telemetry software setup instructions.
DECOM/COMPUTER/LAMP TEST toggle switch	DECOM COMPUTER	Controls the inputs to the IDR/EI display.
	LAMP TEST	In the LAMP TEST position, the number 888 is displayed.

Table 4-24. DDPS Word Formatter Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
MODE rotary switch	NORM THRUPUT	In the normal mode, decom data words are formatted into 16-bit words for transfer to the computer. In the throughput mode, data from the decom is routed through the formatter line receiver/driver to the computer with no data manipulation.
INHIBIT EI/IDR PBI		Inhibits EI and IDR control inputs to the computer, preventing the computer form accepting formatted data. When extinguished, enables the formatter to transfer formatted data to the computer.
642B/TDC switch		Routes the formatter output to either the 642B computer or the TDC.

4.2.3.9 Model 636 Level Shifter

a. The Model 636 TTL/642B Level Shifter is a general-purpose device which translates TTL signal levels to negative levels for data transfers to a 642B computer. The level shifter performs the function of interfacing two Model 403 Frame Synchronizers to the input/output channels of a Model 642B computer.

b. The Model 636 contains two identical but independent channels. In each channel, a maximum of 30 TTL signals are level shifted to 642B-compatible levels, two control signals from the Model 403 are level shifted to 642B levels, and two control signals from the 642B computer are level shifted to Model 403 levels.

c. Internal patch plugs allow programming of the data signal input lines.

d. Data signal and control signal connections with the Models 403 and 642B are made using balanced, multitwisted pair cables through rear-apron multipin connectors.

e. Test points for the 30 data signals, 4 control signals, and 4 power supply voltages are provided on the front panel (for each channel). In addition, the POWER ON switch and indicator and the power supply failure indicator are provided on the front panel. An elapsed-time indicator is provided internal to the unit.

f. Figure 4-10 is the block diagram of the Model 636 level shifter, table 4-25 lists characteristics, and table 4-26 lists front-panel controls.

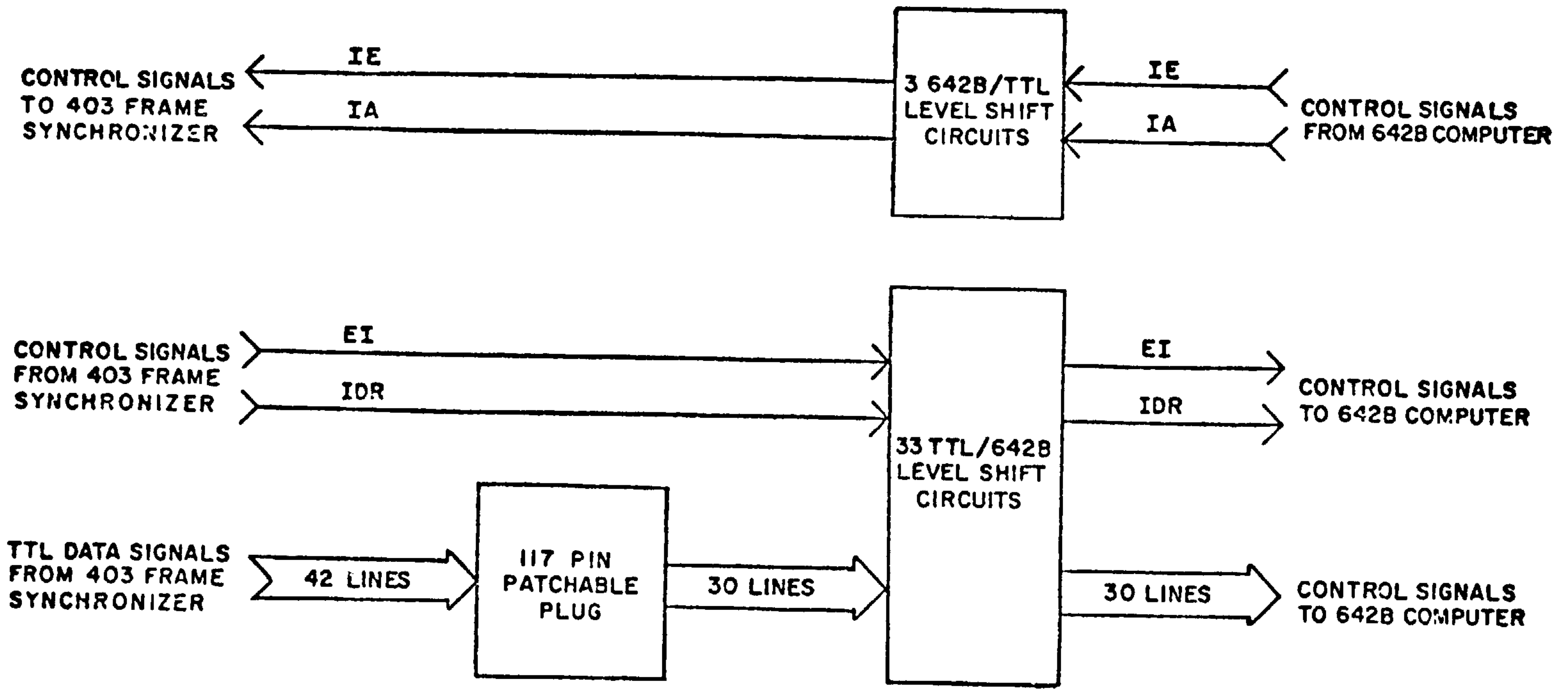


Figure 4-10. Model 636 TTL/642B Level Shifter, Simplified Block Diagram (One Channel)

Table 4-25. Model 636 Level Shifter Characteristics

Parameter	Characteristics
Input Signals	Forty-two (each channel).
Input Levels	Logic 1 = +3.75 ±1.25 V. Logic 0 = 0.0 ±0.5 V.
Input Risetime and Falltime	Less than 180 msec.
Input Impedance	130Ω (each signal).
Thruput Rate	From steady state to 500-kHz square wave.
Output Signals	Thirty (each channel).
Output Levels	Compatible with 642B computer fast interface. Logic 1 = 0.0 ±0.5 V. Logic 0 = -4.5 ±1.5 V.
<u>Control Signals</u>	
Inputs from TTL Peripheral Device	External Interrupt (EI). Input Data Request (IDR).
Inputs from 642B Computer	Input Acknowledge (IA). (Level shifted and applied to TTL peripheral device). Interrupt Enable (IE). (Level shifted and available at output of level shifter).
Levels (IA and IE only)	Logic 1 = 0.0 ±0.5 V from 642B. Logic 1 = +3.75 ±1.25 V to TTL peripheral. Logic 0 = -4.5 ±1.5 V from 642B. Logic 0 = 0.0 ±0.5 V to TTL peripheral.
Test Points	Thirty (0 to 29) data signals. Four (EI, IDR, IA, and IE) control signals. Four (+14, +5, -10, -14V) power supply voltages.

Table 4-26. Model 636 Level Shifter Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Power switch	ON OFF	Applies power to unit.
Power indicator		Indicates power applied to unit.
Power Failure indicator		Indicates power failure.
Elapsed Time indicator		Indicates total operating time (to 10,000 hr full scale).

4.2.3.10 Model 637 Level Shifter

a. The Model 637 642B/TTL Level Shifter is a general-purpose device which translates 642B signal levels to positive levels for data transfers to a pair of Model 403 Frame Synchronizers. The level shifter performs the function of interfacing the input/output channels of a Model 642B Computer to two Model 403 Frame Synchronizers.

b. The Model 637 contains two identical channels. In each channel, a maximum of eighteen 642B signals are level shifted to TTL-compatible levels, one control signal from the 642B is level shifted to a TTL level, and two control signals from the frame synchronizer are level shifted to 642B levels.

c. Internal patch plugs allow programming of all data and control signals after level shifting. Cross-channel patching of the data signals and the 642B/TTL control signals is also provided.

d. Data signal and control signal connections with the Models 642B and 403 are made using balanced, multitwisted pair cables through rear-apron multipin connectors.

e. Test points for the 36 data signals, 6 control signals, and 4 power supply voltages are provided on the front panel. In addition, the power on switch and indicator and the power supply failure indicator are provided on the front panel. An elapsed-time indicator is provided internal to the unit.

f. Figure 4-11 is a block diagram of the 637 level shifter, table 4-27 lists characteristics and table 4-28 lists front-panel controls.

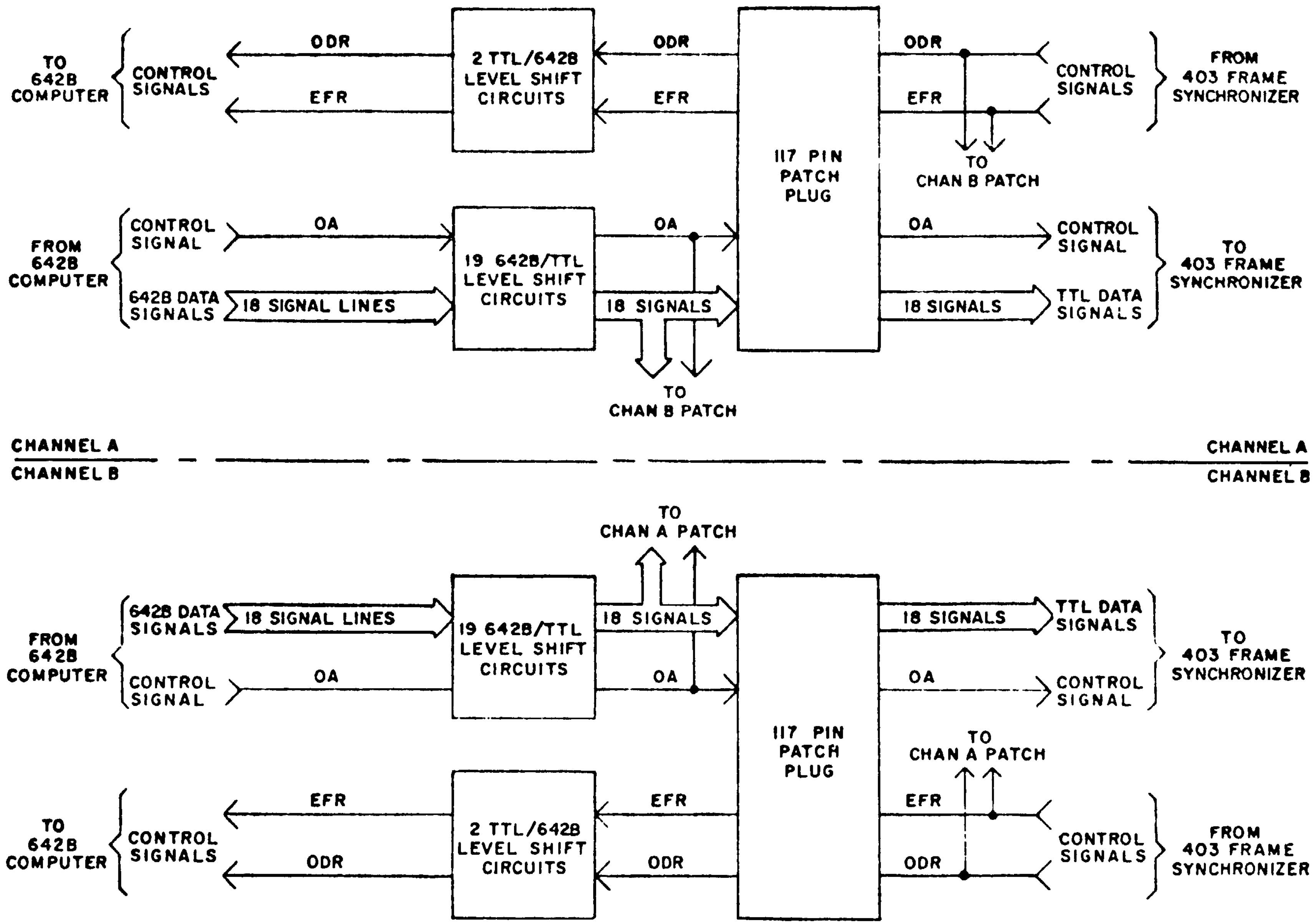


Figure 4-11. Model 637 Level Shifter Simplified Block Diagram

Table 4-27. Model 637 Level Shifter Characteristics

Parameter	Characteristics
Input Signals	Nineteen (each channel).
Input Levels	Logic 1 = 0.0 ±0.5 V. Logic 0 = -4.5 ±1.5 V.
Input Risetime and Falltimes	Less than 180 nsec.
Input Impedance	130Ω (each signal).
Thruput Rate	From steady state to 500-kHz square wave.
Output Levels	
(Compatible with 642B fast interface).	Logic 0 = 0.0 ±0.5 V. Logic 1 = +3.75 ±1.25 V.
Control Signals	Inputs from TTL peripheral device:
	External Function Request (EFR).
	Output Data Request (ODR). Input from 642B Computer.
	Output Acknowledge (OA).
Levels (EFR and ODR only)	Logic 1 = +3.75 ±1.25 V from TTL peripheral.
	Logic 1 = 0.0 ±0.5 V to 642B computer.
	Logic 0 = 0.0 ±0.5 V from TTL peripheral.
	Logic 0 = -4.5 ±1.5 V to 642B computer.

Table 4-28. Model 637 Level Shifter Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Power switch	ON OFF	Applies power to unit.
Power indicator		Indicates power applied to unit.
Power Failure indicator		Indicates power failure.
Elapsed Time indicator		Indicates total operating time (to 10,000 hr full scale).

4.2.3.11 PCM Simulators

a. General

(1) PCM data simulators are used to generate a serial PCM data stream which is then routed to a PCM decommutator to test its operation. Noise and distortion parameters may be introduced as desired. The data can be conditioned with noise, jitter, frequency deviation, and dc offsets or baseline wander. In addition, some simulators contain a bit comparator which compares data processed through the Bit Synchronizer with the simulator output. A counter counts the number of bit error signals which may then be used to compute the bit error rate of the Bit Synchronizer.

(2) Simulators may be controlled and programmed manually or, in some units, may be controlled by a stored program.

(3) Simulators are usually self-contained units and may be used independently of associated equipment for testing telemetry links, magnetic tape recorders, etc.

(4) Block diagrams of typical PCM simulators are shown in figures 4-12 and 4-13.

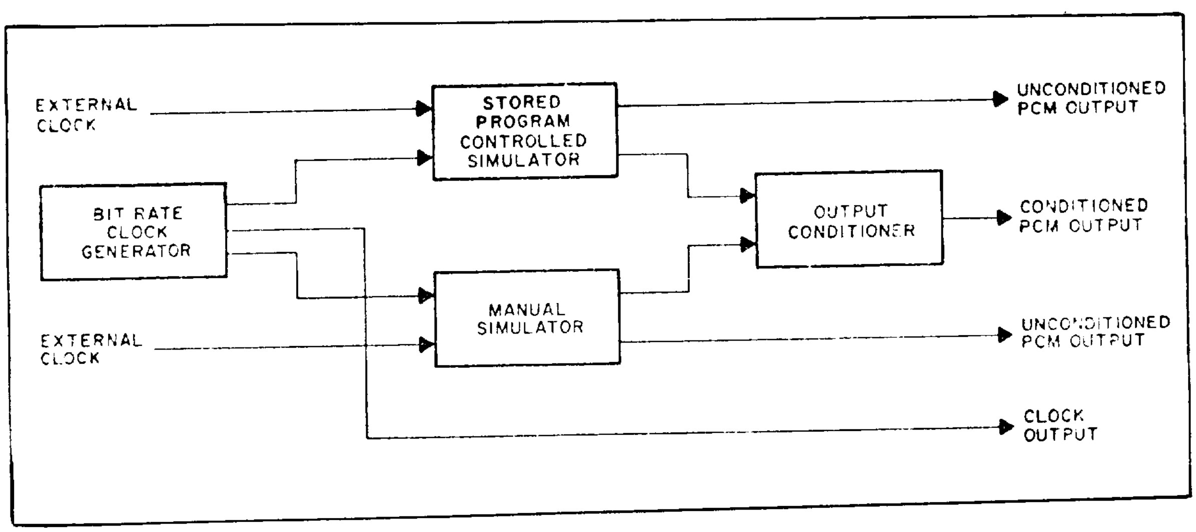


Figure 4-12. Typical Manually Programmable PCM Simulator, Block Diagram

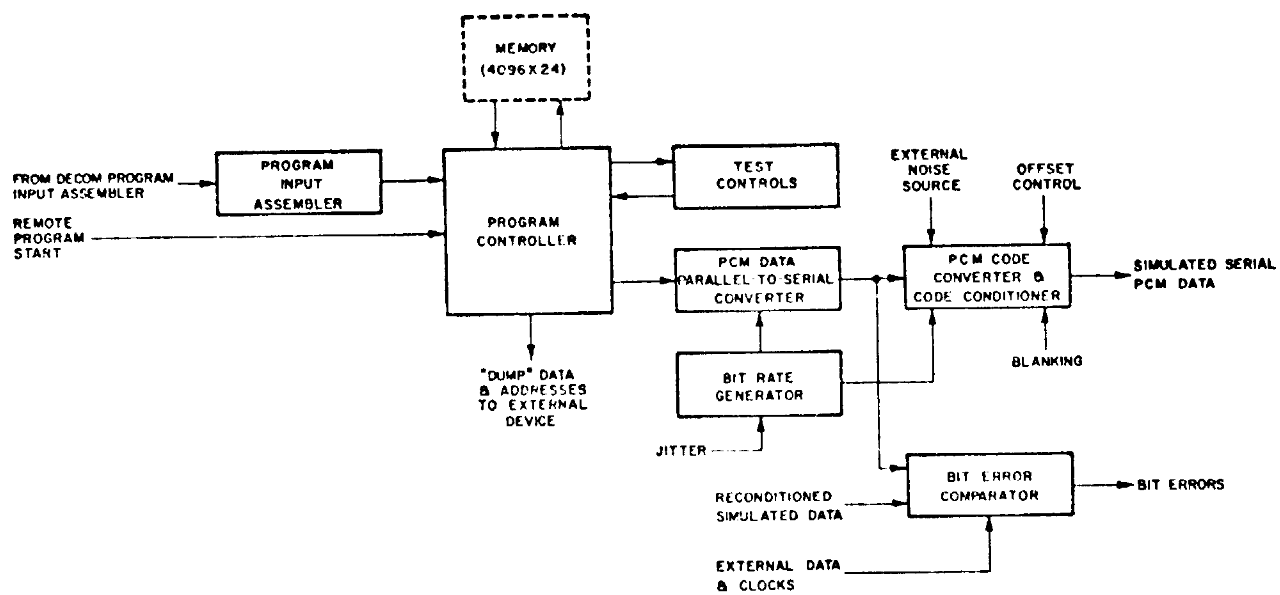


Figure 4-13. Typical Core Programmable PCM Simulator Block Diagram

b. MSFTP-2 PCM Simulator

(1) The MSFTP-2 PCM simulator generates serial PCM wavetrains from preprogrammed core memory storage and from manually-programmed patchboards (both sources may be used simultaneously if desired). Either may be routed through signal perturbation circuits where noise, jitter, dc offset, baseline wander, and pulse rise-time variables are mixed with the serial PCM stream for decom bit synchronizer testing. The stored program section of the unit can simulate static data values of downlink formats, while supplying all commutation ratios, and can be modified in real time by one of the Univac 642B computers providing dynamic data output.

(2) Initial loading of formats into core is accomplished by paper tape, by computer, or manually. After a format is initialized and cycling, modification to the data portion of core can be made manually or by computer without interruption to the data stream being output. The manual section of the unit is necessarily less versatile but has one unique advantage: by means of the common word bit switches, all data words within a field assume the same value. Figure 4-12 illustrates the basic arrangement of the MSFTP-2 simulator. Table 4-29 lists characteristics and table 4-30 lists MSFTP-2 simulator front-panel control functions.

Table 4-29. MSFTP-2 PCM Simulator Characteristics

Parameter	Characteristics
Output Codes	NRZ-L, NRZ-M, NRZ-S, BiØ-M, and SØ.
Conditioned Outputs	Jitter frequency 3 to 3000 Hz. Variable amplitude 0 to 10% of bit period. Baseline variation 3 to 3000 Hz. Continuously variable amplitude up to 50% of signal amplitude. Dc offset amplitude up to 50% of signal amplitude. Signal/noise ratio, variable 0 to 18 dB in 3-dB steps. Rise time unconditioned: less than 150 nsec. Conditioned: 0.2 μsec to 10 msec continuously variable.
Variable Bit Rate	1 bit/sec to 1 Mb/sec.
Logic Levels	Computer input: 1 = 0 V. 0 = -3 to -4.5 V. Bit Comparator input: 1 = 0 V. 0 = -4 to -6.5 V. Conditioned Output: 1 = 0 to +15 V. 0 = 0 to -15 V. Unconditioned Output: 1 = 0 V. 0 = -6 V.

Table 4-30. MSFTP-2 PCM Simulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
Status Controls		
FORMAT switch	LOCAL REMOTE	Selects local or remote operation.
S/N (DB)	Variable (0 thru 18 and ∞)	Selects signal to noise output in 3-dB steps.
BIT RATE switch	FIXED VARIABLE	Selects fixed (predetermined) or variable bit rate.
SYSTEM RESET PB	Momentary	Resets simualtor to original state.
OPERATE/TEST switch	OPERATE TEST	Determines sim mode of operation.
Test		
INITIATE PB	Momentary	Starts test function.
SINGLE CYCLE/ SINGLE STEP switch	SINGLE CYCLE SINGLE STEP	Master clock advances one cycle when in cycle mode or one count when in step mode.
Frequency Section		
BIT RATE DEVIATION switch	-5% 0 +5%	Changes bit rate by the fixed amount indicated.
BIT PER SEC switch	0.001-9.999	Selects output bit rate when in variable mode.
MULTIPLIER switch	1 10 100 1K 10K 100K	Multiplier for variable bit rate.
BIT RATE SELECTOR switch	1 2 3 4 5 6 7 8 9 10	Selects 10 predetermined bit rates.
CHANGE switch	Momentary	Initiates fixed bit rate format change.
OUTPUT CODE switch	As required	Provides output codes of NRZ-L, NRZ-M, NRZ-S, BiØ-M, and SØ.

Table 4-30. MSFTP-2 PCM Simulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
<u>Format Selection</u>		
FORMAT switch	1 2 3 4 5 6 7 8 9 10	Selects preprogramed formats.
CHANGE PB	Momentary	Initiates program format selection.
<u>Clock</u>		
STORED-MANUAL switch	EXT INT	Selects internal or external clock.
<u>Program Entry</u>		
CMPTR/TAPE 5/ TAPE 8 switch	CMPTR TAPE 5 TAPE 8	Selects program entry mode.
TAPE LOAD PB	Momentary	Starts tape reader.
TAPE STOP PB	Momentary	Stops tape reader.
ERROR STOP switch	STOP OFF	Stops tape reader when input error occurs.
<u>Control-Data</u>		
1-0 switches (19)	1/0	Allows manual changes to program.
ADDRESS control	Variable 0000-7777	Selects address for display.
READ PB	Momentary	Changes memory display.
LOAD PB	Momentary	Loads manual program changes.
<u>Blanking</u>		
BLANKING/OFF switch	BLANKING OFF	Turns on blanking circuits.
START BIT control	Variable 1-10	Determines blanking start bit.
START ADDRESS control	0000-7777	Determines blanking start address.
STOP ADDRESS control	0000-7777	Determines blanking stop address.
STOP BIT control	Variable 1-10	Determines blanking stop bit.

c. Model 1280 Data Generator

(1) General. The Model 1280 Data Generator generates up to four independent serial PCM data streams. It consists of four stored program PCM simulators, i.e., Serial Output Units (SOU), a System Control Unit (SCU), an oscilloscope, and a time code generator. The SCU is an LSI-11 microprocessor with an associated VT50 DECscope terminal and dual floppy-disc drives. Each SOU can simulate static data values of downlink formats for all commutation ratios. The SOU's can also accept and insert dynamic data values in the data stream (in parallel binary) from the SCU or external computer and values in analog from an external device. The operator can modify data values using front-panel switches associated with the SOU or the VT50 terminal which is part of the SCU. Figure 4-13A is a basic block diagram of the data generator. Table 4-30A lists SCU characteristics and table 4-30B, the SOU front-panel control functions.

Table 4-30A. Model 1280 Data Generator Characteristics

Parameter	Characteristics
Output Codes	NRZ-L, NRZ-M, NRZ-S, BiØ-L, BiØ-M, BiØ-S, RZ, DM-M, and DM-S
Bit Rate	1 b/sec to 6 Mb/sec
Bit Rate Accuracy	0.02% or better
Outputs	1 to 4 independent serial data streams
Logic Levels	Single-ended Outputs 0 = +0.25 ±0.25V 1 = +2.5 to +6.0V, adjustable Bipolar Outputs 0 = -2.0 to 8.0 V, adjustable 1 = -2.0 to 8.0 V, adjustable Bipolar Output (filtered) 0 = +6.0 ±1.0 V 1 = -6.0 ±1.0 V

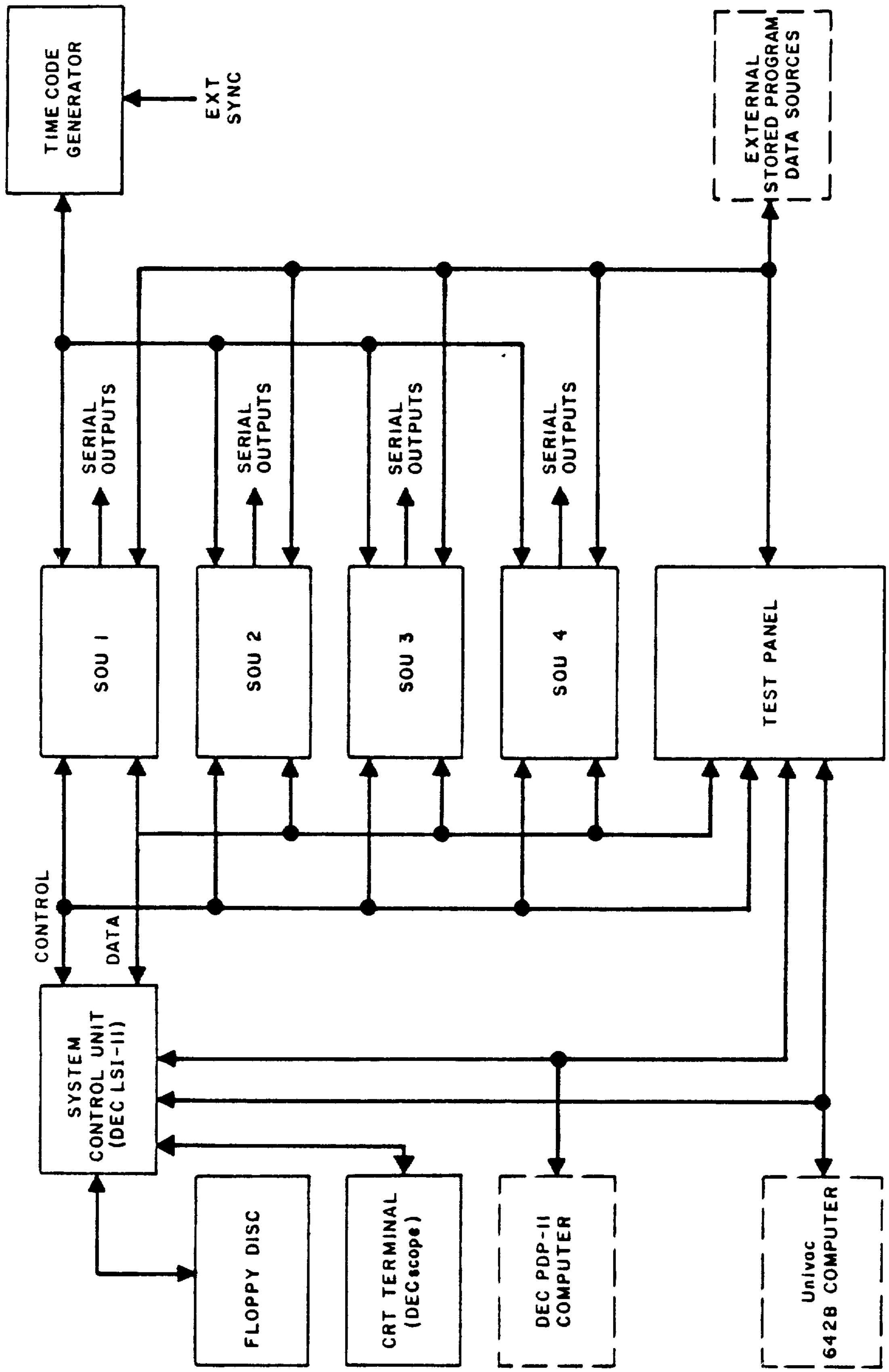


Figure 4-13A. Model 1280 Data Generator Block Diagram

Table 4-30B. Typical SOU Front-panel Controls and Indicators

Control/Indicator	Position	Purpose
ERRORS	Indicator	Six-digit decimal display of errors occurring in a bit error test (BET).
REMOTE	Indicator	When lit, indicates that BET is under remote control.
DATA INV.	Indicator	When lit, indicates that the data stream under test is inverted.
DISPLAY READY	Indicator	When lit, indicates that the bit error display is ready.
OVFL	Indicator	When lit, indicates that the bit error display has overflowed.
ERROR RESET	Momentary PB	When pressed, resets BET logic.
BIT RATE	Indicator	Displays the output bit rate.
REF	INT EXT	Selects reference source for the frequency synthesizer.
MEAS/MAX	MEAS MAX	Selects actual bit rate for display. Selects maximum bit rate for display.
EXT. CLK	Indicator	When lit, indicates that external clock is selected.
FORMAT ID	Indicator	Three-digit octal display of the program ID number.
CODE	DM NRZ BIØ RZ L M S	Indicates the selected code type.
DATA 0-15	Indicator	Sixteen-bit binary display of a selected data word.
RESET	Momentary PB	Resets the data display.
INIT/LD/RD	INIT	Causes the data in the data entry register to be output at the position selected by the WORD/FRAME/SUBFRAME thumbwheels.
	LD	Allows data to be entered in the data entry register.
	RD	Displays selected data on data indicators.

Table 4-30B. Typical SOU Front-panel Controls and Indicators (cont)

Control/Indicator	Position	Purpose
WORD thumbwheels	000 through 999	Selects the word to be displayed on the DATA indicators.
FRAME thumbwheels	000 through 999	Selects the frame number of the word to be displayed on the DATA indicators.
SUBFRAME thumbwheels	0 1 through 5	Disables the FRAME switches. Enables frame selection in one of 5 subframes.
SWITCH DATA	32 PBI's	Used to enter up to 32 bits of data for the data generation program.
RESET	Momentary PB	Resets the SWITCH DATA PBI's.
SENSE 1 through 4	4 PBI's	Programs SENSE switches.
RUN	Indicator	When lit, indicates that the SOU is in run mode.
HALT	Indicator	When lit, indicates that the SOU is in halt mode.
STEP	Indicator	When lit, indicates that the SOU is in step mode.
ADC RANGE	1 2 3	Indicates the Analog-to-digital Converter (ADC) range selected.
EOF	TP1	End-of-frame (EOF) test point, connector PA3D18-12.
EOW	TP2	End-of-word (EOW) test point, connector PA3D18-13.
INT BIT RATE	TP3	Interval bit rate clock test point, connector PA3D18-14.
DSP	TP4	Test point for the selected display word being serialized, connector PA3D18-11.
DIAG	TP5	Test point for the diagnostic location detected, connector PA3D18-8.
BUS 2 ST	TP6	Test point for the bus 2 parallel data available strobe (input from an external device), connector PA3D18-10.
BUS 2 EN	TP7	Test point for the bus 2 parallel data request (output to an external device), connector PA3D18-9.

Table 4-30B. Typical SOU Front-panel Control, and Indicators (cont)

Control/Indicator	Position	Purpose
BUS 1 ST	TP8	Test point for the bus 1 parallel data available strobe (input from an external device), connector PA3D23-13.
BUS 1 EN	TP9	Test point for the bus 1 parallel data request (output to an external device), connector PA3D23-14.
BUS 2 SB	TP10	Test point for the bus 2 serial data input (byte B), connector PA3D23-9.
BUS 2 SA	TP11	Test point for the bus 2 serial data input (byte A), connector PA3D23-10.
BUS 1 SB	TP12	Test point for the bus 1 serial data input (byte B), connector PA3D23-11.
BUS 1 SA	TP13	Test point for the bus 1 serial data input (byte A), connector PA3D23-12.
BUS 2 CKB	TP14	Test point for the bus 2 serial data clock (byte B), connector PA3D23-8.
BUS 2 CKA	TP15	Test point for the bus 2 serial data clock (byte A), connector PA3D23-12.
BUS 1 CKB	TP16	Test point for the bus 1 serial data clock (byte B), connector PA3D28-13.
BUS 1 CKA	TP17	Test point for the bus 1 serial data clock (byte A), connector PA3D28-14.
BET ERRS	TP18	Test point for errors detected during BET, connector PA3D28-11.
BET RCVD DATA	TP19	Test point for received data from an external source, connector PA3D28-10.
BET DLYD DATA	TP20	Test point for SOU-generated data delayed by BET, connector PA3D28-9.
BET PRN DATA	TP21	Test point for BET-generated Pseudorandom Noise (PRN) data, connector PA3D28-8.
SCU DATA TRN	TP22	Test point for SOU/SCU bus data transmitted to SCU's CP (0 through 3), connector PA3D29-11.
SCU NDRY D	TP23	SOU/SCU bus test point for new data ready on data bus strobe, connector PA3D29-12.

Table 4-30B. Typical SOU Front-panel Controls and Indicators (cont)

Control/Indicator	Position	Purpose
SCU IRPT	TP24	Test point for SOU/SCU bus interrupt, connector PA3D29-13.
SCU NDRY C	TP25	SOU/SCU bus test point for new data ready on control bus strobe, connector PA3D29-14.
Test points	TP26, TP27	Not used.
GND	TP28	Test point, ground.
Test points	TP29, TP30	Not used.
SEO SC2	TP31	Test point for single-ended output (selected code 2 serial data), connector J4.
SEO SC1	TP32	Test point for single-ended output (selected code 1 serial data), connector J3.
SEO NRZ-L	TP33	Test point for single-ended output (generated NRZ-L serial data), connector J2.
SEO CK2	TP34	Test point for single-ended output (selected clock 2), connector J7.
SEO CK1	TP35	Test point for single-ended output (selected clock 1), connector J6.
SEO SC3	TP36	Test point for single-ended output, (selected code 3 serial data), connector J5.
BIP SC2	TP37	Test point for bipolar output (selected code 2 serial output), connector J10.
BIP SC1	TP38	Test point for bipolar output (selected code 1 serial data), connector J9.
BIP NRZ-L	TP39	Test point for bipolar output (generated NRZ-L serial data), connector J8.
BIP CK2	TP40	Test point for bipolar output (selected clock 2), connector J13.
BIP CK1	TP41	Test point for bipolar output (selected clock 1), connector J12.

Table 4-30B. Typical SOU Front-panel Controls and Indicators (cont)

Control/Indicator	Position	Purpose
BIP SC3	TP42	Test point for bipolar output (selected code 3 serial output), connector J11.
CLK ÷ N 90°	TP43	Test point for single-ended output (90° clock ÷ N), connector J17.
CLK ÷ N 0°	TP44	Test point for single-ended output (0° clock ÷ N), connector J16.
BIP FIL 2	TP45	Test point for bipolar filtered NRZ-L serial data 2 output, connector J15.
BIP FIL 1	TP46	Test point for bipolar filtered NRZ-L serial data 1 output, connector J14.
EXT INPUT BIT RATE 90°	TP47	Test point for bipolar or single-ended 90° external input clock, connector J20.
EXT INPUT BIT RATE 0°	TP48	Test point for bipolar or single-ended 0° external input clock, connector J19.
EXT INPUT NRZ-L	TP49	Test point for bipolar or single-ended NRZ-L external input data, connector J18.
Test points	TP50, TP51	Not used.
GND	TP52	Test point, ground.
Test points	TP53, TP54	Not used.
ANALOG 1 through 8	TP55 through TP62	Test points used to monitor analog input channels 1 through 8 (all inputs de-coupled through 10-K resistors).
ANALOG 9 through 16	TP63 through TP70	Unwired test points for future analog input channels 9 through 16.
Test points	TP71, TP72	Not used.
GND	TP73	Test point, ground.
Test points	TP74, TP75	Not used.

(2) Operation

(a) System Control. General system control of the data generator is accomplished using an executive program which resides in the SCU memory. The operator can perform all functions of system initialization, control, and data modification by making appropriate typeins on the CRT terminal. In addition to the control provided by the system executive, each SOU has an associated front panel from which the operator can have limited control of the SOU. Loading data formats into individual SOU memories is performed by the system executive. The source of the formats is a disc mounted on one of the disc drives associated with the SCU. Operating procedures provided here are for quick reference only. For more detailed instructions, refer to the associated system technical manuals.

(b) Power-up Procedures. Refer to table 4-30C for power control panel functions and perform the following steps to apply power to the system:

1. Remove any diskettes from the disc drives.

2. On the oscilloscope, set the LINE switch to ON.

3. On the power control panel, set the multisection circuit breaker up.

4. On the power control panel, set the right-hand single circuit breaker up.

5. On the VT50 terminal, set the ON/OFF switch (located on the right side of the unit) to ON. After approximately 1 minute, a blinking cursor should be displayed on the top left portion of the screen.

6. On the power control panel, start with the left single circuit breaker and set all nine breakers up one at a time.

7. On the VT50 keyboard, press RETURN. The @ prompt character should appear on the display.

8. Set the time code generator mode switch to GEN.

(c) Bootstrap Procedures. All manual control functions of the LSI-11 microprocessor are incorporated in the On-line Debugging Technique (ODT) program resident in the micromemory. These functions include examining and modifying memory locations and general registers, and starting the execution of a program in memory. The two functions are required to load or initiate the disc Bootstrap program. Table 4-30D lists the commonly used ODT commands. Procedures are as follows:

1. ROM Bootstrap. To boot an executive program into memory using the Read Only Memory (ROM) Bootstrap, place the diskette

Table 4-30C. Power Control Panel Controls and Indicators

Control/Indicator	Position	Purpose
Breakers		
MAIN	ON OFF	Applies ac power to system.
PS1 through PS8	ON OFF	Applies ac power to power supplies 1 through 8.
Converter outlet	ON OFF	Applies ac power to the outlets for the ADC.
Power and Failure Indicators		
POWER	Indicator	When lit, indicates that the main breaker is on.
DC FAIL, PS1 through PS8	Indicator	When lit, indicates the respective power supply dc output has failed.
OVERTEMP ALARM		
IND	Indicator	When lit, indicates over-temperature.
RESET	Momentary PB	Resets the over-temperature alarm.
OVRD	ON OFF	Disconnects the over-temperature alarm.
Monitors		
ELAPSED TIME	Indicator	Indicates the accumulated system-on time.
Digital readout	Indicator	Used to monitor the dc outputs of the power supplies.
Rotary switch	EXT PS1 +5V PS2 +5V PS3 +5V PS4 +5V PS5 +15V PS6 -15V PS7 +12V PS8 +5V PS9 -5V	Selects an external input. Selects PS1. Selects PS2. Selects PS3. Selects PS4. Selects PS5. Selects PS6. Selects PS7. Selects PS8. Selects PS9.

Table 4-30D. ODT Commands

Terminal Input	Function
(RETURN)	Close opened location and accept next command.
(LINE FEED)	Close current location and open next sequential location.
↑	Open previous location.
←	Take contents of opened location as absolute address and open that location.
r/	Open the word at location r.
/	Reopen the last location.
$n/ or Rn/	Open general register n (0 through 7) or S (processor status register).
r;G or rG	Go to location r and start program.
RUBOUT	Erases previous numeric character, response is a backslash.
P	Resume execution of the program at the location indicated by the current contents of the program counter (R7).

in a disc drive (normally drive 0) and perform the following:

a. In response to the @, enter:

173000G
$ (echoed by computer)
$DX0 (disc drive 0) or $DX1 (disc drive 1)
(CR)

b. The ROM Bootstrap begins execution.

2. Manually Loaded Bootstrap. To use the manually loaded Bootstrap program, it must first be loaded in memory. Table 4-30E lists the ODT prompts and typeins for two Bootstrap loaders. After making these entries, start execution of the Bootstrap by entering:

1000G

(d) Start-up System. The program is delivered on floppy diskette, in binary-loadable form, in a standard RT-11 format (Vol. 1 of 3, No. 299-004-000-3A). In order to start, the user should perform the following:

1. Insert the diskette (No. 299-004-000-3A) in the left-hand disk drive (0).

2. Execute one of the Bootstrap procedures described in paragraph 4.2.3.11c(2)(c).

3. The bootstrap system is read into memory. The terminal displays:

TYPE Y FOR PRINTED DIRECTORY

4. Enter a Y on the VT50 keyboard. The terminal displays the disk directory, as follows:

1. DGEXEC SAV 2. MEMORY TST 3. FREQ. TST 4. DRSIS.SAV.

5. Enter the number identifying the program (1, 2, 3, or 4). Although any of the four programs could be loaded, this section is confined to the operation of the data generator system control unit executive, the program used for normal telemetry operations.

6. Enter 1 (CR) on keyboard. The terminal displays:

LOADING

7. The VT50 terminal displays:

DATA GENERATOR SYSTEM EXECUTIVE
ENTER SOU MEMORY SIZES INTO RO-R3
AND ALIEN CODE IN R4
DEFAULT VALUES ARE RO-R3 = 3777 (2K)
R4 = 0 (642B)

Table 4-30E. RXVII Bootstraps

Full Length Version	Abbreviated Version (Drive 0 Only):
@1000/000000 12702 (LF)	@1000/000000 5000 (LF)
001002/000000 1002n7 (LF)*	001002/000000 12701 (LF)
001004/000000 12701 (LF)	001004/000000 177170 (LF)
001006/000000 177170 (LF)	001006/000000 105711 (LF)
001010/000000 130211 (LF)	001010/000000 1776 (LF)
001012/000000 1776 (LF)	001012/000000 12711 (LF)
001014/000000 112703 (LF)	001014/000000 3 (LF)
001016/000000 7 (LF)	001016/000000 5711 (LF)
001020/000000 10100 (LF)	001020/000000 1776 (LF)
001022/000000 10220 (LF)	001022/000000 100405 (LF)
001024/000000 402 (LF)	001024/000000 105711 (LF)
001026/000000 12710 (LF)	001026/000000 100004 (LF)
001030/000000 1 (LF)	001030/000000 116120 (LF)
001032/000000 6203 (LF)	001032/000000 2 (LF)
001034/000000 103402 (LF)	001034/000000 770 (LF)
001036/000000 112711 (LF)	001036/000000 0 (LF)
001040/000000 111023 (LF)	001040/000000 5007 (CR)
001042/000000 30211 (LF)	
001044/000000 1776 (LF)	
001046/000000 100756 (LF)	
001050/000000 103766 (LF)	
001052/000000 105711 (LF)	
001054/000000 100771 (LF)	
001056/000000 5000 (LF)	
001060/000000 22710 (LF)	
001062/000000 240 (LF)	*n = 4 for Unit 0
001064/000000 1347 (LF)	n = 6 for Unit 1
001066/000000 122702 (LF)	(LF) = Line Feed
001070/000000 247 (LF)	(CF) = Carriage Return
001072/000000 5500 (LF)	Starting address = 1000
001074/000000 5007 (CR)	

(e) At this time, if necessary to operate remotely from a PDP-11 processor, enter the following:

$4/ 1 (CR)

(f) Enter P to start program execution.

(3) SOU operation

(a) To load a program into an SOU, enter:

Ls, fmt, drive (CR)

where: S = the number of the SOU.

fmt = the format number (refer to the applicable Telemetry Software Catalog [TESOC]).

drive = the disc drive number.

(b) To initiate execution of the program by the SOU, enter:

Cs, I

Cs, R

where: s = the SOU number.

(c) The SOU should be outputting data. Table 4-30F lists SCU executive commands.

(4) Data Generator Software Distribution

(a) Data generator software is initiated and controlled by Code 852.2.

(b) Software is distributed by mailing one diskette to each station. An OPN that lists all the formats available on that particular disc is issued concurrently.

(c) Data generator diskettes are authorized on the PCM software SSI and identified by a code number and the date of issue. The code number is in the format DG-A-01; the number 01 refers to the first diskette issued, and is incremented by one for each subsequent issue.

(d) When an updated version of the data generator diskette is received by the stations and is authorized by the PCM software SSI, the stations retain the old diskettes for reuse. Diskette copies may be made onstation using the current duping software.

(e) Each data generator format is listed as a sequence number and a format number (in octal). The sequence number is the existing PCM mission number for other software, followed by the letters DG.

Table 4-30F. SCU Executive Commands

Typein	Function/Description
Ls, form, drive	Load SOU(s) with format No. (form) from disc unit (drive).
Ms, loc/xxxxxx yyyyyy	Memory display/change (s = SOU No., loc = memory address, yyyyyy = new value).
Fs, func/xxxxxx yyyyyy	Setup register display/change (s = SOU No., func = register No., yyyyyy = new value).
Cs, cond	Control command (s = SOU No.), cond = one of the following: I = initiate setup R = run H = halt S = step P = proceed C = clear
Ds, drive	Dump from SOU(s) to disc (drive).
Bs	Enter BET routines for SOU(s).
T = .001*10**n	n = time interval
B = 10**n	n = bit interval
Dnn	nn = decimal whole bit delay
D+++	Each + = 1/4-bit delay
P or P-	PRN or PRN not
I or I-	Invert data or not invert
R	BET remote
G or S	Go or stop
BELL	Return control to local.
A	Assign control to remote computer.
ESC	Return control from step.

Note

1. Underlined characters are program output; those not underlined are operator input.

2. All numeric inputs are hexadecimal except BET whole-bit delay and format number which are octal.

3. All commands terminate with carriage return. M and F commands allow LF terminator to sequence forward and backward.

(f) The TESOC for the data generator is in Telemetry Software Catalog (TESOC) for the LSI-11 Microprocessor, Setup Controller (SUC), Data Synchronizer Setup Controller (DSSC), and Data Generator (DG), STDN No. 515.5.

4.3 PAM/PDM DATA HANDLING

4.3.1 GENERAL

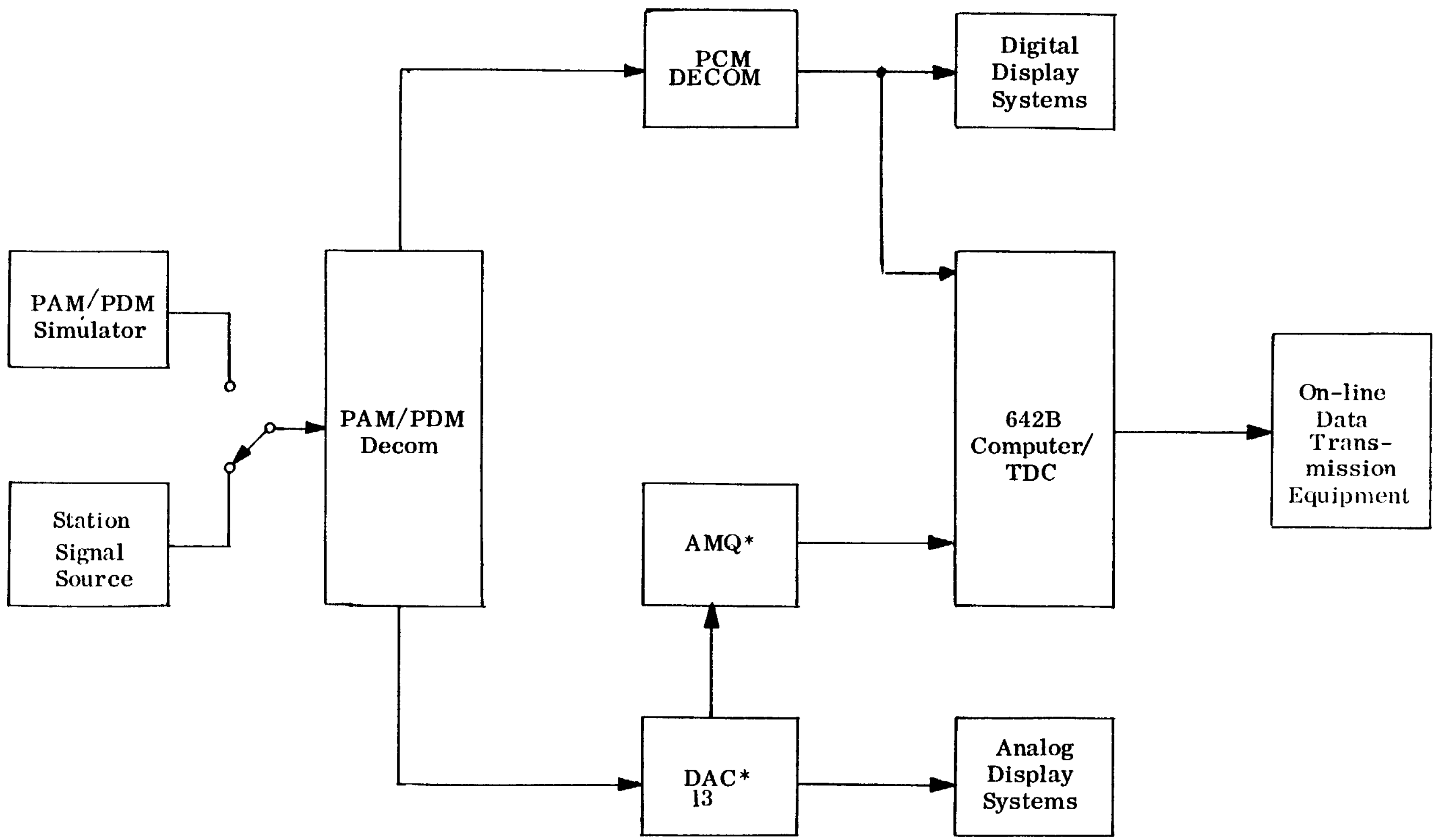
The PAM/PDM decommutators receive serial pulse coded time-division-multiplexed video wavetrains. The data information is contained in the amplitude of the pulses in the case of PAM, and in the width of the pulses in the case of PDM. Data systems used in the STDN accept the incoming PAM or PDM data and convert it into a PCM or digital pulse train. The data may then be routed to computer for further processing or to PCM or analog display and/or recording systems as required. Figure 4-14 is a generalized block diagram of a PAM/PDM data handling system.

4.3.2 DDF-13

4.3.2.1 PAM/PDM Data Handling Equipment. The Model DDF-13 converts incoming PAM or PDM data into PCM form. It processes PAM (NRZ and RZ) having 30-to 90-percent duty cycles (on RZ) at pulse (channel) rates from 1.0 to 10,000-p/sec and at amplitudes from 1.0 to 100 Vpp. It processes PDM 4.0- to 15-percent duty cycles for level, and 45- to 70- percent duty cycles for gain at channel rates from 1.0 to 5000 p/sec. Input impedance of DDF-13 is greater than 10,000 ohms. The DDF-13 can be programmed to process up to 999 main frame channels and 999 subframe channels. In each channel, the data is reformatted into 10-bit binary words. The eight MSB's are the output in parallel form to a computer and in serial form (NRZ-L) to a PCM system. A computer buffer inhibit switch is provided to inhibit the transfer of data to the computer. For those parameters selected for DAC-13 processing, the output is all 10 bits. The DDF-13 synchronizes on either the standard IRIG master pulse (pulse 2 or 3) or on any special four-channel pattern with each channel having five possibilities: (1) not considered, (2) 0 percent, (3) 50 percent, (4) 100 percent, and (5) missing. The equipment acquires and maintains synchronization with a 12-dB (S:N) input with the bandwidth limited to five times the channel rate. A Sync/Lock (S/L) switch is provided on the DDF-13 to facilitate selection of up to nine consecutive undetected synchronization patterns without jeopardizing synchronization. This switch is normally set to zero and used only when data recovery is desired regardless of reliability. A low-pass Krohn-Hite filter (Model 3200R-Z) may be used to precondition the PAM/PDM data prior to processing. The filter is, unless otherwise specified, initially set to provide a cutoff frequency that is five times the input data rate. After the data acquisition, the filter can be tuned to minimize noise without distorting the signal. Figure 4-15 is a block diagram of the DDF-13, and table 4-31 lists equipment characteristics. Table 4-32 lists the computer buffer outputs, and table 4-33 lists the front-panel control functions.

4.3.2.2 DDF-13 Guardband Adjustment. Adjustment procedures are as follows:

a. Verify channel frame synchronization as indicated on the front-panel SYNC status indicators, and ensure that the LEVEL and GAIN SERVO PBI's are de-energized.



* Equipment configuration to be used is dependent upon mission requirements.

Figure 4-14. Generalized Basic PAM/PDM Handling System Block Diagram

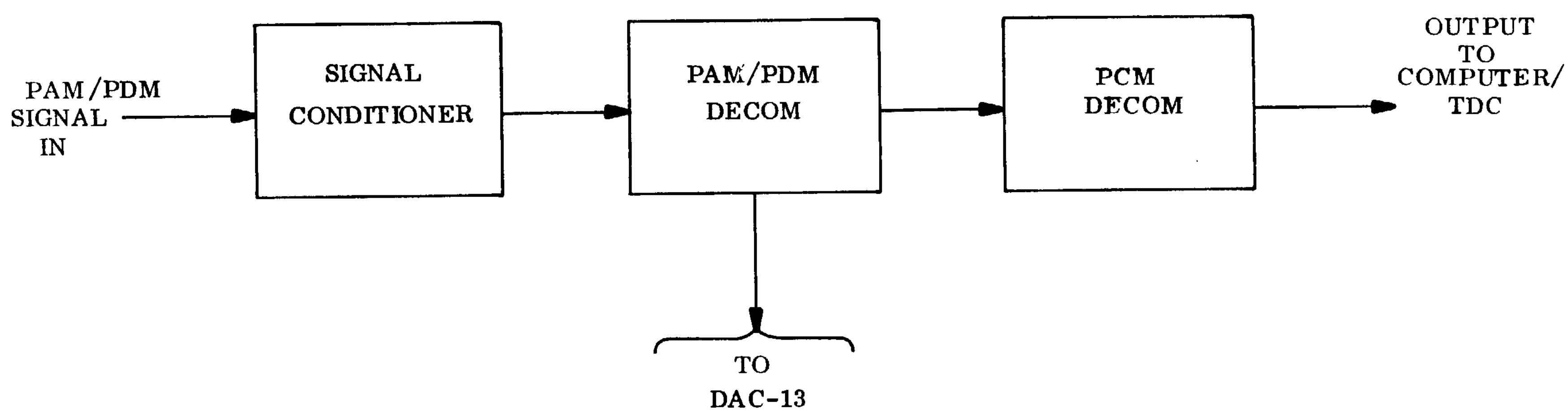


Figure 4-15. Model DDF-13 Block Diagram

Table 4-31. Digital Data Formatter (DDF-13) Characteristics

Parameter	Characteristics
<u>Input Signal</u>	
Data Format	PAM/NRZ. PAM/RZ. PDM.
Rate	1 to 10,000 p/sec (PAM-RZ/NRZ). 1 to 5,000 p/sec (PDM).
<u>Synchronization</u>	
Frame	Standard IRIG master pulse in all modes; any special four-channel pattern, each channel having five possibilities: (1) Not considered. (2) 0%. (3) 50%. (4) 100%. (5) Missing.
Main Frame Length	Up to 999 channels.
Subframe	One subframe with up to 999 channels.
<u>Output Data</u>	
Analog-to-digital Conversion	± The least significant bit.
Serial PCM Output	Eight binary bits/channel coded NRZ-L.
Logic Level	Logical 1 = 0V. Logical 0 = -5V.
Digital-to-analog Converter	Parallel 10 bits binary data plus strobe.

Table 4-32. Model DDF-13 Computer Buffer Output

J628 PIN	DATA BIT
9	0 OUT
10	1 OUT
22	2 OUT
23	3 OUT
24	4 OUT
25	5 OUT
26	6 OUT
27	7 OUT
19	0 RETURN
20	1 RETURN
33	2 RETURN
34	3 RETURN
35	4 RETURN
36	5 RETURN
37	6 RETURN
38	7 RETURN
75	MAIN FRAME LOCK
85	MAIN FRAME LOCK RETURN
3	EXTERNAL INTERRUPT (EI)
13	EXTERNAL INTERRUPT RETURN
1	INPUT DATA REQUEST (IDR)
11	INPUT DATA REQUEST RETURN
2	INPUT ACKNOWLEDGE (IA)
12	INPUT ACKNOWLEDGE RETURN

Table 4-33. Model DDF-13 PAM/PDM DHE Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
▼ FRAME SYNC SELECT switch	IRIG 2/3 SYNC PATTERN	Set to correspond to downlink sync.
▼ L.E. switch	ON OFF	Controls use of leading edge of sync pulse.
▼ MODE switch	PAM+ PAM- PDM+ PDM- NRZ+ NRZ-	Set to downlink code type.
DATA INPUT switch	1 2 3 4 5 6	Selects 1 of 6 data input jacks.
METER SELECT switch	RATE DEV LEVEL GAIN	Selects mode of front-panel meter readout.
▼ CHANNEL RATE switch	1-5 5-25 25-125 100-500 5-2.5K 2.5-10K	Selects downlink data channel rate (coarse).
VAR control	Variable	Fine tunes channel rate.
GAIN control	Variable	Adjusts level of gain servo.
LEVEL control	Variable	Adjusts level of level servo.
▼ DATA TRANSFER switch	ON OFF	Controls data transfer to computer. ON after acquisition of signal.
▼ L.E. SENS control	Variable 0-9	Selects point of leading edge detection. Specified in NOSP when required.
▼ BANDWIDTH control	Variable 0-9	Selects loop filter BW.
▼ SAMPLE DELAY control	Variable 0-9	Selects point of pulse for data sampling. Specified in NOSP when required.
DISPLAY SELECT switch	ZERO REF F.S.REF MF SF MF-SF	Selects source for binary display.

▼ Specified in NOSP.

Table 4-33. Model DDF-13 PAM/PDM DHE Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
MAIN FRAME OUT switch	Momentary	Resets main frame synchronizer.
SUBFRAME OUT switch	Momentary	Resets subframe synchronizer.
CALIBRATE switch	0 20 40 50 60 80 100 0 50 100 INFO	Supplies internal calibrate levels.
▼ PCM FRAME SYNC CODE (16 switches)	1/0	Selects output PCM frame sync code.
Frame Format		
SYNC PATTERN (4 switches)	OFF 100 50 0 MC	Used to select special downlink sync pattern.
▼ S/L switch	Variable 0 - 9	Selects number of sync errors before dropping lock.
▼ LAST PULSE - 1 control	Variable 000 - 999	Set for last downlink pulse minus 1.
▼ LAST PULSE control	Variable 000 - 999	Set for last downlink pulse.
▼ ZERO REF control	Variable 000 - 999	Set for zero reference chan in downlink.
▼ FULL SCALE REF control	Variable 000 - 999	Set for full-scale reference chan in downlink.
DISPLAY control	Variable 000 - 999	Allows selection of one downlink channel for binary display.
Subframe Format*		
SYNC PATTERN (4 switches)	OFF 100 50 0 MC	Used to select special downlink sync pattern.
▼ S/L control	Variable 0-9	Selects number of subframe sync errors before dropping lock.

*Specified in NOSP when required.
▼ Specified in NOSP.

Table 4-33. Model DDF-13 PAM/PDM DHE Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
▼ LAST PULSE 3 controls	Variable 000 - 999	Set to last pulse of downlink.
▼ M.F. LOCATION 3 controls	Variable 000-999	Selects location in main frame of subframe.
DISPLAY 3 controls	Variable 000-999	Selects channel in subframe to drive binary display.
TEST switch	0-9	Selects internal test points to front-panel jack.
SERVO GAIN PBI	ON (lit)	Applies power to gain servo.
SERVO LEVEL PBI	ON (lit)	Applies power to level servo.
<u>Krohn-Hite Filter</u>		
▼ LOW PASS HIGH PASS switch	LOW PASS X1 X10 X100 X1K X10K HIGH PASS X1 X10 X100 X1K X10K	Selects filter mode and frequency range.
▼ CUTOFF FREQ. HZ control	Variable 9-105	Selects exact cutoff frequency.

▼ Specified in NOSP.

b. Set the DISPLAY SELECT switch to ZERO REF, and adjust the level control so that the display lamps indicate 0000000110 (unless otherwise specified in the NOSP).

c. Set the DISPLAY SELECT switch to FS REF, and adjust the gain control so that the display lamps indicate 1111111001 (unless otherwise specified in the NOSP).

d. Repeat steps b and c to remove any interaction between the level and gain control adjustments.

e. Energize the LEVEL and GAIN SERVO PBI's one at a time, while observing the corresponding ZERO reference and FS reference display indications. If either indication is more than (plus or minus) one bit from the indications in steps b and c, an alignment of the corresponding servo card is required.

4.3.3 MODEL DAC-13 DIGITAL-TO-ANALOG CONVERTER

The Model DAC-13 Digital-to-analog Converter (DAC) accepts the DDF-13 digital wavetrain which was converted to parallel binary data words of 10 bits for each PAM channel, and reconverts them to analog outputs for use by external equipment. Ten DAC's are available for use, and any one of the ten may be assigned to a specific channel, providing a total capability of 10-channel monitoring. The output is 0 Vdc for 0-percent (no bits present) and +10 Vdc for 100-percent (10 bits present). Any combination of up to nine channels can be cross-tied. A meter display indicating 0- to 100-percent full scale and a CHANNEL select switch are located on the front panel to monitor any of the output channels. Figure 4-16 is a block diagram of the model DAC-13, table 4-34 lists equipment characteristics, and table 4-35 lists the front-panel control functions.

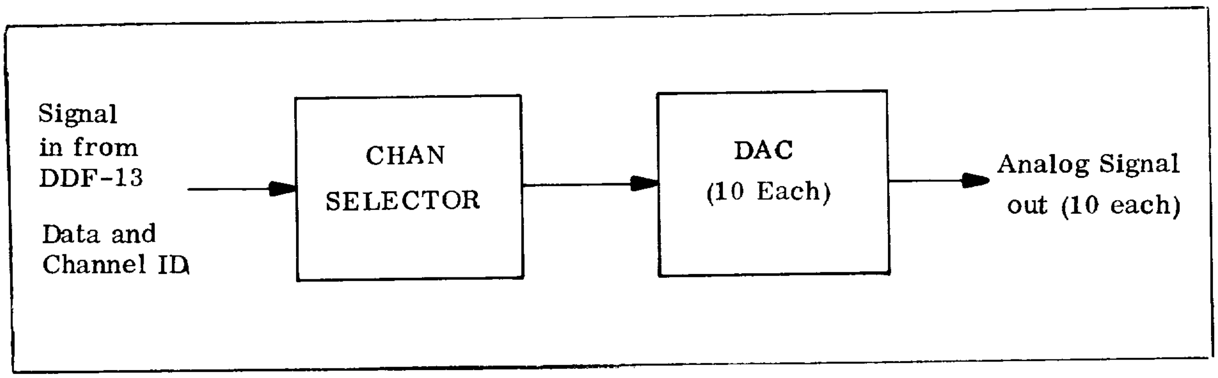


Figure 4-16. Model DAC-13 Block Diagram

Table 4-34. Model DAC-13 Characteristics

Parameter	Characteristics
Input	
Binary Data	Parallel 10-bit binary data, 1 to 10,000 p/sec rate.
Cross Tie-in	Nine individual signals.
Output	
Binary Data Interface	Parallel 10-bit binary data.
Analog Outputs	Ten.
Analog Output Voltage	0 Vdc for 0% (0 bits). +10 Vdc for 100% (1024 bits).
Analog Output Offset	±1 Vdc min.
Accuracy	0.1% of full-scale data.

Table 4-35. Model DAC-13 Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	<u>ON</u>	Applies power to unit.
CHANNEL switch	1-10	Selects channel to be displayed on the meter.
CHANNEL controls (10)	Variable 000-999	Selects which channel will be converted.
C.T. controls (10)	Variable 0-9	Allows DAC's to be tied together in the case of supercommutation.
M.F./S.F. switch (10)	M.F. S.F.	Selects either mainframe or subframe data to be processed by the DAC's.

4.3.4 STELLARMETRICS SS-13 PAM/PDM SIMULATOR

The Stellarmetrics SS-13 PAM/PDM Simulator is used to check out and verify the PAM/PDM data formatter subsystem. The simulator can generate PAM in RZ and NRZ codes and PDM pulse trains. Signal perturbations are either generated by an internal jitter circuit or input from an external noise source if desired. Bit rates from 1 to 10,000 p/sec are available. Variation of all parameters (amplitude, duration, duty cycle, etc.) of the simulator output signal is controlled from the front panel. Figure 4-17 is a block diagram of the SS-13, table 4-36 lists equipment characteristics, and table 4-37 lists front-panel control functions.

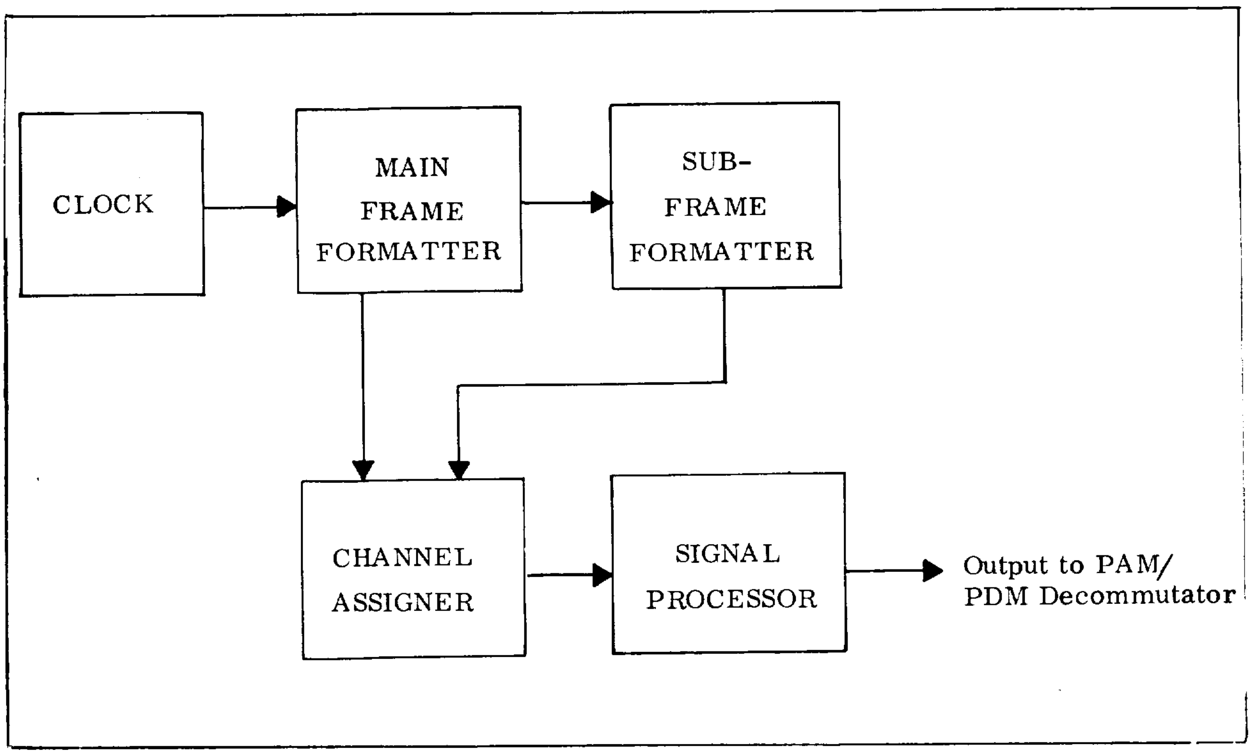


Figure 4-17. Stellarmetrics SS-13 Simulator Block Diagram

Table 4-36. Stellarmetrics SS-13 Simulator Characteristics

Parameter	Characteristics
Output Mode Format	PAM-RZ, PAM-NRZ-PDM, IRIG, STANDARD or SPECIAL.
Channel Rate	1 to 10,000 p/sec in all modes.
Frame Length	5 to 999 channels in both main frame and subframe.
PAM Output Voltage	0 to +10 Vpp.
PDM Output Voltage	0 to +10 Vpp.
Channel Data Level	Selectable 0 to 100%.
Main-frame Sync Pulse Level	Adjustable from -50% to 120% of full-scale data.
Channel Rate Modulation	Internal: 60 Hz, 0 to ±30% of nominal rate. External: dc to 50 kHz, 0 to ±30% of nominal rate.

Table 4-37. Stellarmetrics SS-13 Simulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
MISSING CHAN switch	OFF 1 2 3 5 7 10 15 20 30 SPL 50%	Selects missing channels as desired.
BASE LINE control	Variable	Controls baseline output voltage of PAM wavetrain.
FILTER switch	ON	Applies power to data filter.
FILTER control	Variable	Controls amount of data filtering.
PDM ZERO control	Variable	Controls width of PDM zero percent pulses.
PDM F.S. control	Variable	Controls width of PDM 100 percent pulses.
POLARITY switch	+ -	Selects data output polarity.
OUTPUT GAIN control	Variable	Controls data output amplitude.
OUTPUT LEVEL control	Variable	Controls data output dc offset.
NOISE switch	ON	Applies power to internal noise gen.
NOISE control	Variable	Controls amount of internal noise added to data output.
GROUP 1-2-3-4-5-6-7-8-9-10 (10 switches)	EXT VAR 100 80 60 50 40 20	Assigns data values to output channels as indicated in multiples of 10; i.e., Group 5 switch controls channel 5-15-25-35-45, etc.
SPECIAL CHANNEL control	Variable 000-999	Used for special channel assignment.

Table 4-37. Stellarmetrics SS-13 Simulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
SPECIAL DATA switch	EXT VAR 100 80 60 50 40 20 0	Assigns data value to special channel.
F. S. REF control	Variable	Assigns full scale reference channel.
ZERO REF control	Variable	Assigns zero reference channel.
F. S. REF control	Variable	Controls level of full scale channel.
ZERO REF control	Variable	Controls level of zero reference channel.
RESET M. F. switch	Momentary	Resets main frame generator.
RESET S. F. switch	Momentary	Resets subframe generator.
IRIG M. P. AMPL control	Variable	Controls gain of sync pulse when in IRIG.
FRAME SYNC FORMAT (MAIN FRAME) switch	M.F.IRIG 2 M.F.IRIG 3 MAIN FRAME PATTERN	Selects sync pulse format for mainframe.
MAIN FRAME PATTERN switch	MC 0 50 100 OFF	Selects sync pulse amplitudes when in mainframe pattern format selection.
SUB. FRAME PATTERN switch	MC 0 50 100 OFF	Selects sync pulse amplitudes when in subframe pattern format selection.
FRAME SYNC FORMAT (SUBFRAME) switch	S.F. IRIG 2 S.F. IRIG 3 SUBFRAME PATTERN	Selects sync pulse format for subframe.
DUTY CYCLE control	Variable	Adjusts duty cycle when in RZ mode.
MODE switch	PAM RZ PAM NRZ PDM	Selects output mode.
SUB FRAME LOCATION control	Variable 000-999	Selects which mainframe channel contains the subframe.
SUB FRAME LENGTH control	Variable 000-999	Selects how many channels are in subframe.

Table 4-37. Stellarmetrics SS-13 Simulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
MAIN FRAME LENGTH control	Variable 000-999	Selects how many channels are in mainframe.
RATE PPS switch	.1X1 9.9X1K Variable	Selects data channel rate.
RATE MODULATION AMPLITUDE control	Variable	Used to control the rate jitter for testing.
RATE MODULATION switch	OFF EXT INT	Turns on internal jitter circuits for testing.
DEVIATION control	Variable -20 0 +20	Changes channel rate for testing.

4.4 ANALOG-TO-DIGITAL CONVERTERS

4.4.1 GENERAL

Analog-to-digital (A-D) converters are used to digitize analog data for processing in digital type equipment, such as a computer.

4.4.2 ANALOG MULTIPLEXER QUANTIZER (EMR AND DYNATRONICS 101)

4.4.2.1 The Analog Multiplexer Quantizer (AMQ) is a time-division multiplexer quantizer that accepts analog data and quantizes each data channel into equivalent 8-bit parallel words for direct interface with the 642B computers. Operating characteristics are as follows:

a. Analog input: 128 channels maximum (determined by modules).

b. Analog input voltage range: 0 to +10 volts (single-ended).

c. Sample period: 6.6 μsec for the Dynatronics and 5.5 μsec for EMR.

d. Channel select control: sequential or addressable.

e. Output: quantized data, 8 bits parallel.

f. Sample data rate: 1 to 60,000 smp/sec.

4.4.2.2 Data processing can be controlled locally by manual programming, or remotely by the computer. Computer control is accomplished by using the following five 16-bit instructions.

a. Mode select.

b. Channel address.

c. Recycle channel.

d. Sample rate No. 1.

e. Sample rate No. 2.

4.4.2.3 The AMQ data output to computers consists of eight lines from the output data register and three control lines for Interrupt (signaling the beginning of a data frame), input data request (signaling the computer coincident with each data channel), and overflow (signaling the computer that it did not acknowledge an Interrupt or input data request). An Acknowledgement pulse from the computer is the input to the AMQ to acknowledge an input data request.

4.4.2.4 Figure 4-18 is a block diagram of a typical AMQ. Table 4-38 lists EMR equipment characteristics and table 4-39 lists Dynatronics equipment characteristics. Table 4-40 lists EMR AMQ front-panel control functions and table 4-41 lists Dynatronics 101 AMQ front-panel control functions. AMQ computer buffer connections are listed in table 4-43.

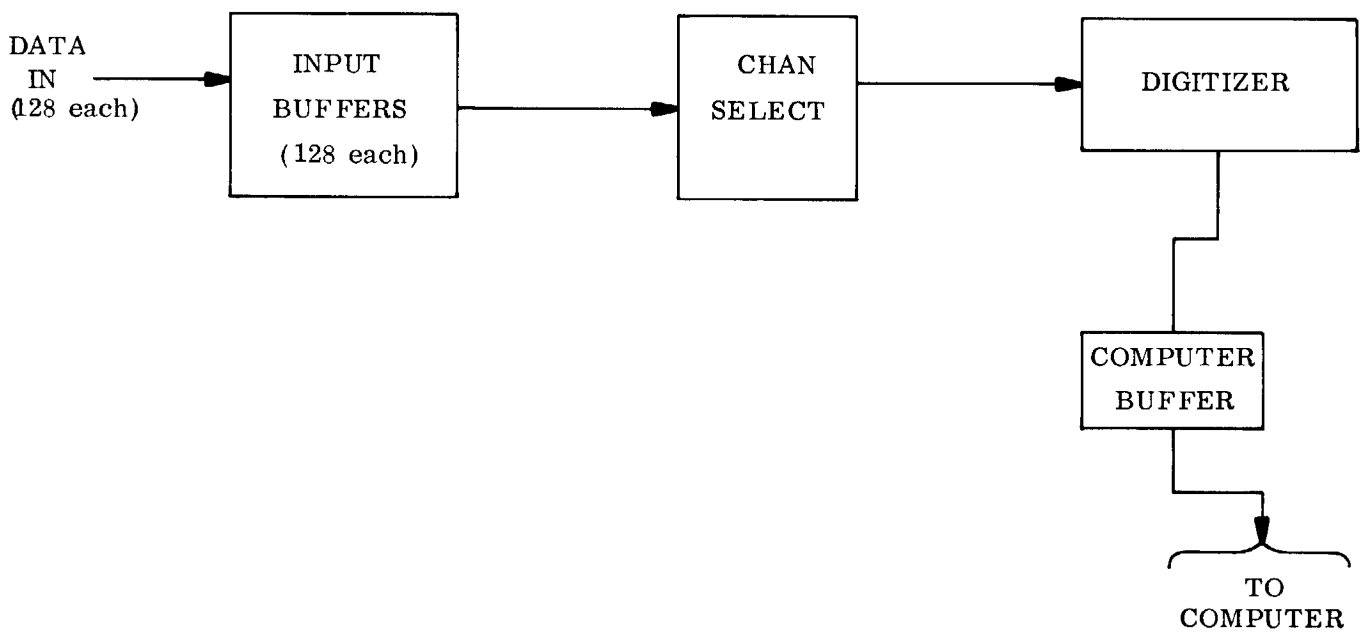


Figure 4-18. Typical AMQ Block Diagram

Table 4-38. EMR AMQ Characteristics

Parameter	Characteristics
Input	0 to +10 V.
Input Impedance	10 MΩ during sample times, 50 MΩ during off time.
Number of Channels	128 max.
Sample Period	5.5 μsec.
AMQ Modes (LOCAL or REMOTE)	Synchronous sequential. Synchronous addressable. Asynchronous sequential. Asynchronous addressable.
Quantized Data	Eight bits parallel.
Accuracy	±0.05 percent.
Logic Levels:	Logic 1 = +3 to +5 V. Logic 0 = 0 V.

Table 4-39. Dynatronics AMQ Characteristics

Parameter	Characteristics
Input	0 to +10 V.
Input Impedance	10 MΩ during sample times, 50 MΩ during off time.
Number of Channels	128 max.
Sample Period	6.6 μsec.
AMQ Modes (LOCAL or REMOTE)	Synchronous sequential. Asynchronous sequential. Synchronous addressable. Asynchronous addressable. Test mode.
Quantized Data	Eights bits parallel.
Accuracy	±20 mV.
Logic Levels	Logic 1 = +2.4 to 4.2 V. Logic 0 = +0.2 to 0.4 V.

Table 4-40. EMR AMQ Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
▼SAMPLE RATE control	Variable	Selects channel sample rate.
▼MODE switch	SS	(Synchronous Sequential) Permits sequential channel sampling.
	AA	(Asynchronous Addressable) Requires external clock or ADV switch may be used for IDR clocking.
	AS	(Asynchronous Sequential) Permits sequential channel advancing or manual channel advancing when not in SS mode.
	SA	(Synchronous Addressable) Permits sequential channel sampling or an addressable sampling.
CHANNEL ADDRESS control	Variable	Selects one channel for fron-panel display.
▼RECYCLE CHANNEL	Variable	Selects recycle channel.
CHANNEL control	Variable	Selects channel for front-panel display.
CONTROL switch	LOCAL REMOTE	Selects local front panel or computer operation.
INHIBIT DATA switch	IN OUT	Inhibits data to the computer. Inhibit until acquisition of signal.
ADV PB	Momentary	Advances channels when in AS mode only.

▼Specified in NOSP.

Table 4-41. Dynatronics AMQ Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
▼ RECYCLE CHANNEL	Variable	Sets recycle channel.
DECOM ADDRESS control	Variable	Selects any channel for front-panel display on A/D DECOM DATA display.
▼ SAMPLE RATE control	Variable	Sets channel sample rate.
▼ CHANNEL ADDRESS control	Variable	Selects input channel to be digitized when in add mode.
MODE switch	TEST OPERATE	Inhibits data to computer when in TEST position.
MODE switch	LOCAL REMOTE	Selects local front-panel or remote computer operation.
▼ MODE switch	SEQ ADD	Permits sequential channel sampling or addressable sampling.
▼ MODE switch	SYNC ASYNC	Permits sequential channel advancing or manual channel advancing.
ADVANCE ENCODE PB	Momentary	Manually advances channel sampling when in async mode.

▼ Specified in NOSP.

Table 4-42. AMQ Computer Buffer Connections

Connector	Pin	Buffer Bit	Mode Select	Recycle Channel	Chan Address	Sample Rate 1	Sample Rate 2
Computer Instruction/Operation							
J5	49	15	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.
J5	48	14	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.
J5	47	13	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.
J5	32	12	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.	UNIT NO.
J5	31	11	FUNCTION CODE (0)	FUNCTION CODE (1)	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (0)
J5	30	10	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (1)	FUNCTION CODE (1)
J5	29	9	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (1)	FUNCTION CODE (0)	FUNCTION CODE (1)
J5	28	8	FUNCTION CODE (1)	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (0)	FUNCTION CODE (0)
J5	27	7				MSB	MSB
J5	26	6		MSB	MSB	MOST SIG	LEAST SIG
J5	25	5				DIGIT	DIGIT
J5	24	4		RECYCLE	RECYCLE	LSB	LSB
J5	23	3	ASYNC ADD	CHANNEL	ADDRESS	MSB	
J5	22	2	SYNC ADD			NEXT MOST	X1K
J5	10	1	ASYNC SEQ			SIG DIGIT	X100
J5	9	0	SYNC SEQ	LSB	LSB	LSB	X10
J5	2		OUTPUT DATA REQUEST (ODR)				
J5	1		OUTPUT DATA ACKNOWLEDGE (ODA)				

Table 4-42. AMQ Computer Buffer Connections (cont)

Data Transfer		
Connector	Pin	Data Bit
J4	27 + 38	7
J4	26 + 37	6
J4	25 + 36	5
J4	24 - 35	4
J4	23 - 34	3
J4	22 - 33	2
J4	10 + 20	1
J4	9 + 19	0
J4	48 + 59	DATA OVERFLOW
J4	3 + 13	EXTERNAL INTERRUPT (EI)
J4	1 + 11	INPUT DATA REQUEST (IDR)
J4	2 + 12	INPUT ACKNOWLEDGE (IA)

4.5 DATA TRANSMISSION SYSTEM ENCODER/DECODER EQUIPMENT

4.5.1 GENERAL

4.5.1.1 The Data Transmission System (DTS) encoders and decoders described are specialized equipment used as links in encoding and decoding data signals between stations and a distant control point.

4.5.1.2 In general, a serial PCM data flow destined for transmission is routed to the encoder. The encoder then retransmits the data to a modem where the data (still a serial PCM bit flow) modulates a subcarrier. The subcarrier is then transmitted to the distant station. During this process, the encoder inserts the PCM data into a standard format, which provides for inserting sync and routing codes, GMT, or fill bits as necessary.

4.5.1.3 On arrival at the receiving station, the subcarrier is routed to another modem. Output of the modem is the serial PCM bit stream originally generated by the encoder. This data is forwarded to a decoder where the data is converted to its original format and forwarded to the user for use as required. The decoder can also supply the user with the data clock rate if desired.

4.5.1.4 Figure 4-19 is a generalized DTS diagram, and table 4-43 shows Station Equipment Allocation. ME 3108 illustrates DTS program. Patchboard patching, (only used when time or auxiliary data is required), will be specified in the applicable NOSP when required.

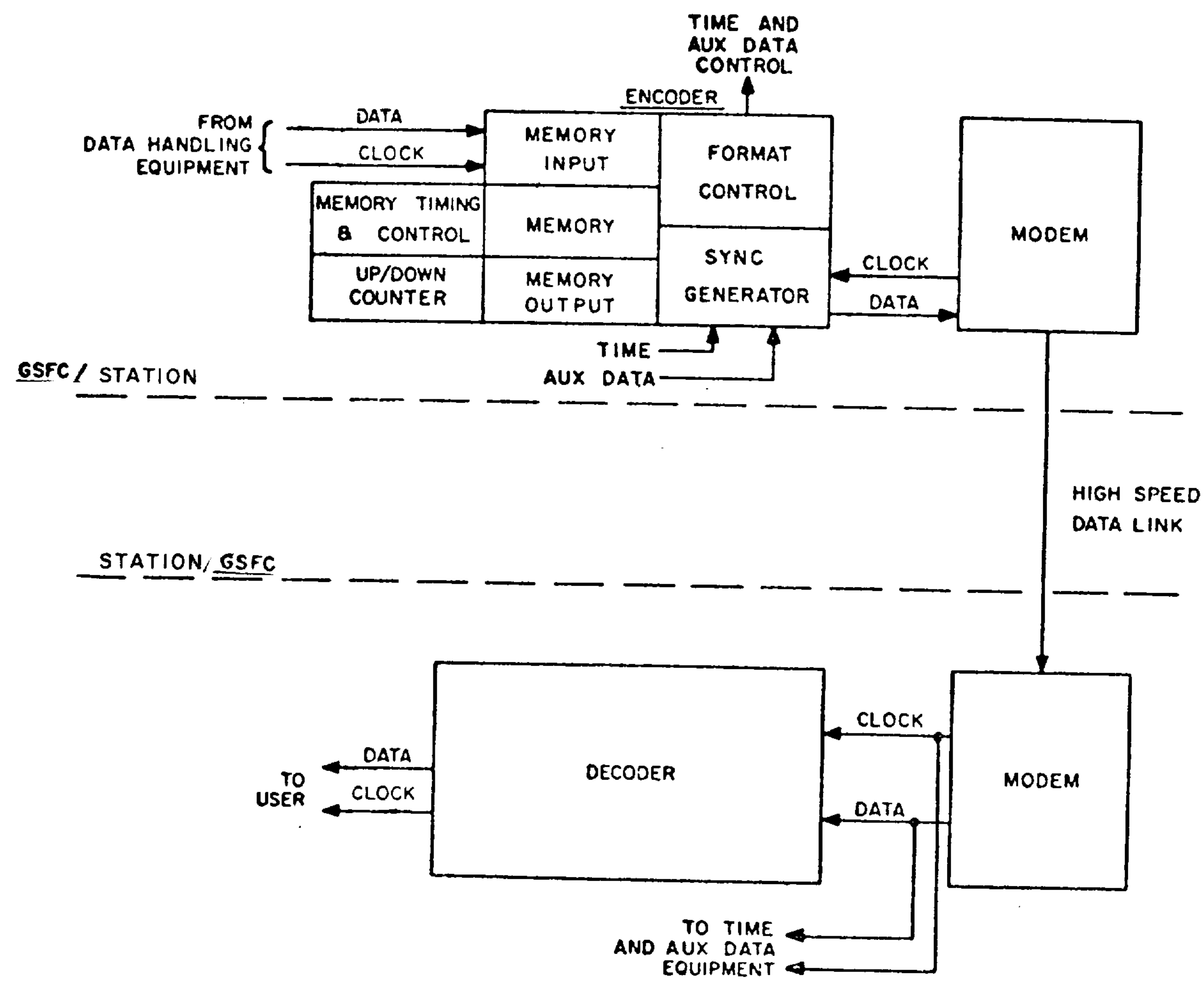


Figure 4-19. Typical Data Transmission System Application

Table 4-43. Station DTS Encoder/Decoder

Station	DTS Encoder Type
ACN	E9
AGO	E9/D114
GWM	E9
MIL	E111
ORR	E9/D114
QUI	E9/E111/D114
ROS	E9/D114
ULA	E111A/D114
WNK	E9/D114

4.5.2 MODEL E9 ENCODER

4.5.2.1 The Model E9 Encoder accepts incoming PCM data in NRZ-L form, and transmits converted code in NRZ-L form. An input-output diagram is shown in figure 4-20. Input and output levels and frequencies used are listed in table 4-44. Front-panel control functions are listed in table 4-45.

4.5.2.2 In addition to normal functions, provision has been made for modifying the unit, where applicable, to accept an auxiliary serial PCM data input.

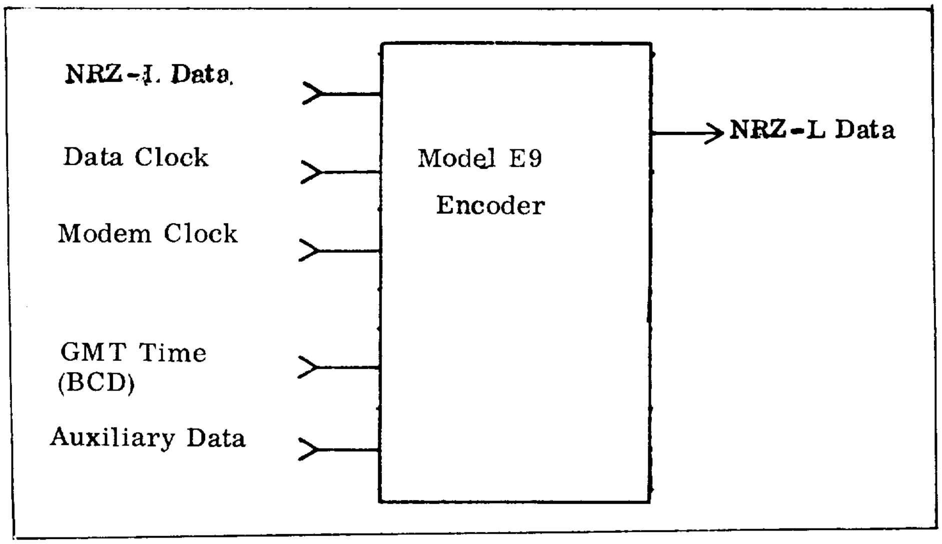


Figure 4-20. Model E9 Encoder Input-output Diagram

Table 4-44. Model E9 Encoder Characteristics

Parameter	Characteristics
Input Signal Requirements	
Code	NRZ-L.
Frequency	Prewired program plug, not to exceed 7.2 kb/sec.
DHE Data and Clock Logic Levels	One (-6 Vdc), Zero (0 Vdc), or One (+5 Vdc), Zero (0 Vdc).
Data Modem Clock Logic Levels	One (-6 Vdc), Zero (+6 Vdc).
Ouput Signal Characteristics	
Code	NRZ-L.
Frequency	Determined by data modem.
Logic Levels	One (-9 Vdc), Zero (+9 Vdc and +11 Vdc at no load).
Memory Capability	400 bits.

Table 4-45. Model E9 Encoder Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
Drawer 2		
AC POWER switch	ON/OFF	Applies ac power.
AC POWER indicator		Lights when ac power switch is set to the ON position.
MEMORY % FULL meter	0 - 100%	Indicates relative loading of memory.
METER ADJUST control		Permits calibration of MEMORY % FULL meter.
TEST MODE indicators		Wired in parallel. Light to indicate at least one test switch not in NORMAL position.
HEADER switches		To set NASCOM routing header.
▼SOURCE (3)	0 - 7	
▼DESTINATION (3)	0 - 7	
▼FORMAT	0 - 7	
OUTPUT TO MODEM indicator		Flashes when a 1 is transmitted to the data modem.
SERIAL DATA GO indicator		Lights when acutal serial data are being assembled in a data frame and transmitted.
TIME TAG GO indicator		Lights when time tag is being transmitted.
AUX DATA GO indicator		Lights when auxiliary data are being transmitted.
DATA OUTPUT switch	ON/OFF	Starts the encoder when set to the ON position.
▼TIME TAG switch	ON OFF	When set to the ON position, routes GMT tag to the encoder output.
▼AUX DATA switch	ON OFF	In the ON position, routes interface data to the encoder output.
NASCOM BLOCK LENGTH switch	600 1200 2400 3600 4800 NONE	Sets bit length of NASCOM block.

▼Specified in NOSP.

Table 4-45. Model E9 Encoder Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Drawer 2 (cont)		
MEMORY ERROR indicators		If memory momentarily empties, left-hand indicator lights and remains lit until reset. If memory momentarily overflows, right-hand indicator lights and remains lit until reset.
RESET PB	Momentary	When pressed, turns off lighted MEMORY ERROR indicators.
Drawer 1		
FRAME SEARCH indicator		Indicates satellite frame sync recognition circuits out of sync and in satellite frame search mode.
FRAME CHECK indicator		Indicates system in self-check satellite frame sync mode.
FRAME LOCK indicator		Indicates satellite frame counter is in sync.
PATCHBOARD		Sets length and sync pattern of satellite frame.
CONFIRMED indicator		Indicates system recognized last satellite frame pattern.
FLYWHEEL indicator		Indicates system did not recognize last satellite frame sync pattern.
Drawer 1 Test and Jack Panel 1		
DELAY LINE ADJUST switch	TEST NORMAL	When set to TEST position, allows adjustment of the SM-30 delay line.
BIT SYNC SIMULATE/ NORMAL switch	SIMULATE NORMAL	In SIMULATE position, allows input of test signals to the data buffer.
BIT SYNC DATA switch	Up Down	Generates test data; up equals binary 1.
BIT SYNC MANUAL CLOCK switch	Up Down	Simulates input clock for testing when cycled up and down.
MODEM SIMULATE NORMAL switch	Up Down	In up position, allows testing of data buffer output and fill generator operation.
MODEM MANUAL CLOCK switch	Up Down	Simulates data modem clock when cycled up and down.

4.5.3 MODEL E111 ENCODER

The Model E111 Encoder, in addition to accepting and transmitting NRZ-L codes, can also accept an auxiliary PCM input for simultaneous transmission with the primary data. An input-output diagram is shown in figure 4-21. Encoder characteristics are listed in table 4-46 and controls and indicators are listed in table 4-47.

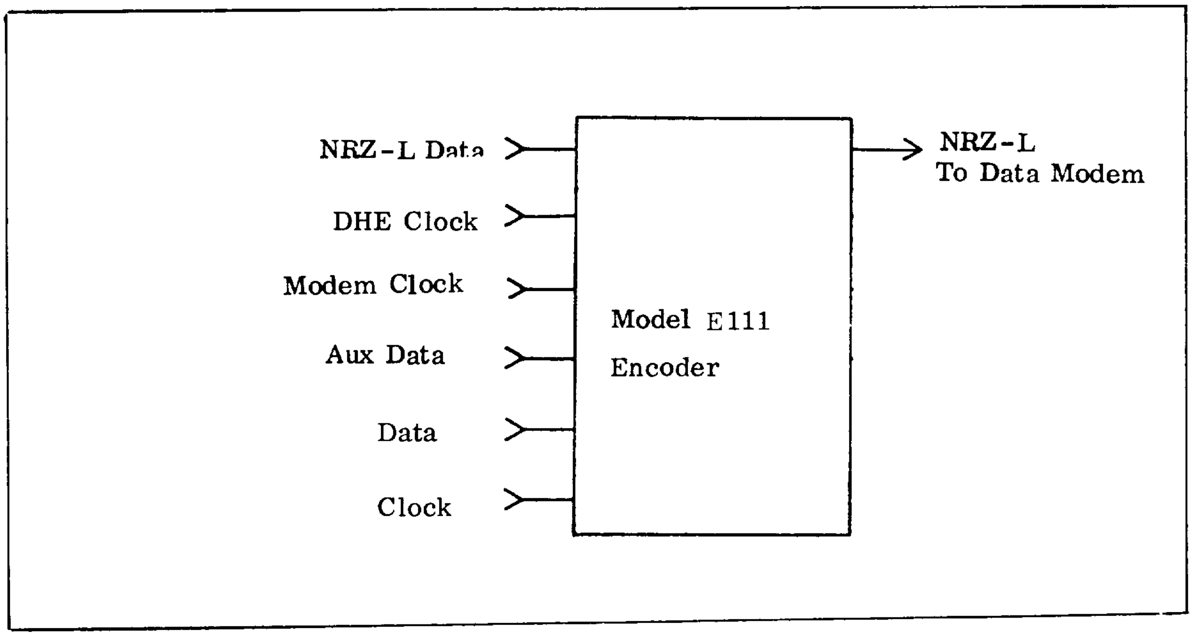


Figure 4-21. Model E111 Encoder Input-output Diagram

Table 4-46. Model E111 Encoder Characteristics

Parameter	Characteristics
Inputs	
Format	NRZ-L.
Bit Rate	7.2 kb/sec maximum (up to 20 kb/sec capability, determined by data modem).
Minimum Pulse Width	25 nsec.
Station DHE data and clock levels	
Logic 1	+2.5 to 5.5 V.
Logic 0	0 to +1.0 V.
Data Modem Clock Level	
Logic 1	-20 V max.
Logic 0	+20 V max.
Time and Auxiliary Data Signals	
Logic 1	+2.5 to +5.5 V.
Logic 0	0 to +1.0 V.
Outputs	
Format	NRZ-L.
Bit Rate	Determined by data modem.
Data Levels	
Logic 1	-12 V.
Logic 0	+12 V.
Memory Capability	1024 eight-bit words.

Table 4-47. Model E111 Encoder Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
▼NASCOM HEADER switches	0 - 9	For setting of NASCOM routing header. Three switches for source, three switches for destination, and three switches for format.
DATA INPUT indicator		Lights when serial data is being received by the encoder. Lights only during a 1.
SERIAL DATA GO switch	ON OFF	When set to ON, switch starts encoder operation.
SERIAL DATA GO indicator		Lights when serial data is being inserted in the output data frame. Lights only during serial data portion of frame.
▼AUX DATA GO switch	ON OFF	Allows auxiliary data to be inserted in fill frames.
AUX DATA GO indicator		Lights when auxiliary data is being handled. Lights only during auxiliary data portion of frame.
▼TIME GO switch	ON OFF	Switch ON allows time tag to be inserted in fill frames.
TIME GO indicator		Lights when time tag is being handled. Lights only during time tag portion of frame.
DATA TO MODEM indicator		Flickers when data stream is being transfered to data modem.
MEMORY ERROR EMPTY PBI	Momentary	Lights when memory is empty, and remains lighted until pressed. Indicator extinguished.
MEMORY ERROR FULL PBI	Momentary	Lights when memory is full, and remains lighted until pressed. Indicator extinguished.
DATA BITS/ADDRESS BITS PBI's (10)	Momentary	During normal operation, only the indicators are used; these display a binary number which indicates the number of 8 bit words in memory. Not used during data transmission. In the monitor mode (MONITOR PBI lit), the indicators monitor memory input and output data and input and output addresses as determined by settings of SYSTEM TEST switch.

▼Specified in NOSP.

Table 4-47. Model E111 Encoder Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
DATA BITS/ADDRESS BITS PBI's (10) (cont)		In the test mode (TEST PBI lit), the pushbuttons may be used to present the input and output address registers as determined by settings of SYSTEM TEST switches.
▼ BLOCK LENGTH	600/1200/ NONE	Selects bit per NASCOM block.
SYSTEM TEST		
MONITOR PBI	In Out	When lit, allows the use of DATA BITS/ADDRESS BITS indicators to monitor memory input and output data and input and output addresses as determined by setting of SYSTEM TEST switches.
DATA PBI	In Out	When lit, selects the input or output data register for test as determined by settings of INPUT and OUTPUT pushbuttons. Indicator lights when pushbutton is pressed.
ENABLE PB	In Out	When pressed in test mode, causes memory read-in or read-out as determined by settings of INPUT and OUTPUT PBI's. Used in test mode only.
ADDRESS PBI	In Out	When lit, selects the input or output address register for test as determined by settings of INPUT and OUTPUT pushbuttons. Indicator lights when pushbutton is pressed. Not used during data transmission.
OUTPUT PBI	In Out	When lit, selects the output data or address register for test as determined by settings of ADDRESS and DATA pushbuttons. Indicator lights when pushbutton is pressed.
CLEAR PB	Momentary	When pressed in test mode, clears data and address registers. Do not press during data transmission.
INPUT PBI	In Out	When lit, selects the input data or address register for test as determined by settings of ADDRESS and DATA pushbuttons. Indicator lights when pushbutton is pressed.
TEST PBI	In Out	In TEST position (indicator lit), allows the use of DATA BITS/ ADDRESS BITS PBI's to preset the input data register and output address registers.

▼ Specified in NOSP.

4.5.4 MODEL E111A ENCODER

The Model E111A Encoder operates similar to those previously discussed, significant differences being primarily limited to bit rate capability and voltage levels acceptable. An input-output diagram is shown in figure 4-22. Unit characteristics are listed in table 4-48 and front-panel control functions are listed in table 4-49. Figure 4-23 shows typical data transmission system message formats.

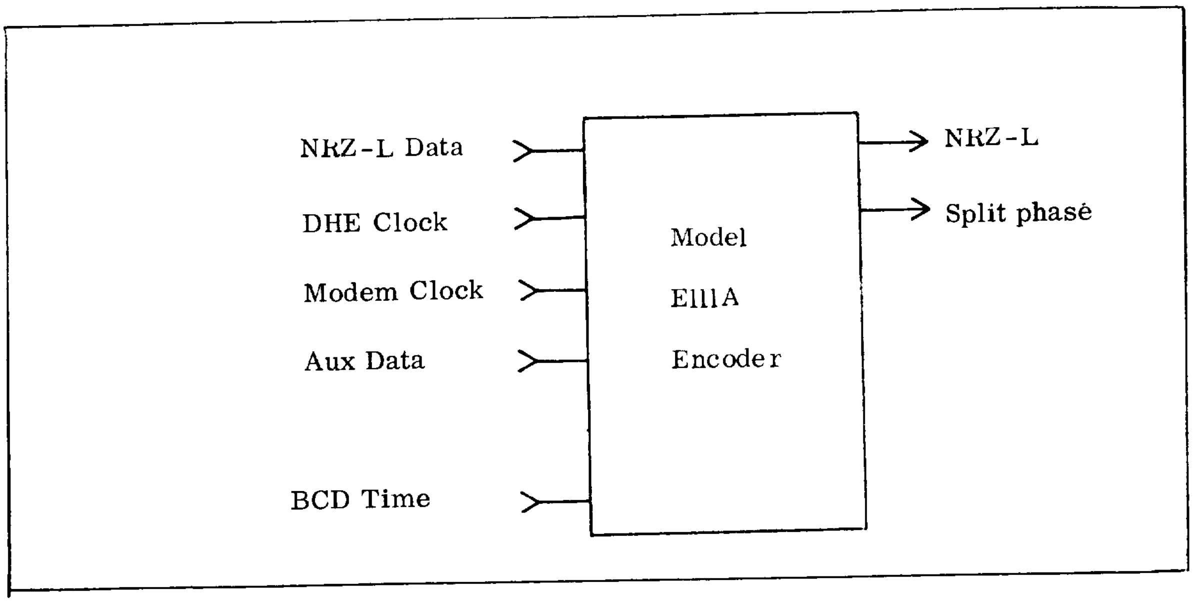


Figure 4-22. Model E111A Encoder Input-output Diagram

Table 4-48. Model E111A Encoder Characteristics

Parameter	Characteristics
Inputs	
Format	NRZ-L.
Bit Rate	56 kb/sec max.
Station DHE Data and Clock Levels	
+Logic 1	+5 to +20 V.
+Logic 0	0 to -20 V.
-Logic 1	-5 to -20 V.
-Logic 0	0 to +20 V.
Data Modem Clock Levels	
Logic 1	-5 to -20 V.
Logic 0	+5 to +20 V.
Time and Auxiliary Data Signals	
Logic 1	+2.5 to +5.5 V.
Logic 0	0 to +1.0 V.
Outputs	
Format	NRZ-L.
Bit Rate	Determined by data modem, not to exceed 56 kb/sec.
Data Levels	
Logic 1	-12 V.
Logic 0	+12 V.
Time and Auxiliary Data Control Signals	
Logic 1	+2.5 to +5.5 V.
Logic 0	0 to +1.0 V.
Memory Capability	1024 eight-bit words.

Table 4-49. Model E111A Encoder Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
DATA/ADDRESS PBI's (10)	Momentary	Display input or output test patterns or addresses as determined by MONITOR switch. Not used during data transmission.
MCL indicator		Flashes to indicate presence of modem clock and to indicate that the system is formatting.
▼ NASCOM HEADER switches	0 - 9	For setting of NASCOM routing sync patterns. (Source, destination,and format.)
▼ SYNC CODE switch		Selects sync codes used in producing selected message format.
		Sync Code
	0	No formatting.
	1	Frame Sync Enable (FSE)
	2	Header Sync Enable (HSE), header sync 600 (HS6), and FSE.
	3	HSE, header sync 1200 (HS12), and FSE.
	4	Block Sync Enable (BSE), HSE, header sync 600 (HS6), and Error Code Enable (ECE).
	5	BSE, HSE, HS12, and ECE.
	6	BSE, HSE, HS6, and ECI.
	7	BSE, HSE, HS12 and ECI.
	8, 9	For future use.
▼ INPUT DATA switch		Six positions are used to select data as follows:
		Input Data
	0	Serial Data Enable (SDE).
	1	Time Send Enable (TSE) and SDE.
	2	Auxiliary Data Enable (ADE) and SDE.
	3	Parallel Data Enable (PDE).
	4	TSE, PDE.
	5	PDE, ADE.
	6, 7	For future use.
	8, 9	Not used.
TEST PBI	In Out	In the test mode (indicator lit), allows memory input or output data or addresses to be monitored while test patterns are transferred through memory.
RESET PB	Momentary	When pressed, clears memory and all applicable registers and flip-flops. Do not press during data transmission.
INPUT indicator		Flashes to indicate data is present at input.
OUTPUT indicator		Flashes to indicate data is being unloaded from memory.

▼Specified in NOSP.

Table 4-49. Model E111A Encoder Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
OVERFLOW PBI	Momentary	Lights to indicate that memory storage has reached 90 percent of capacity and remains lit until pressed. Indicator extinguished.
MONITOR switch	LAMP TEST OUTPUT ADDRESS INPUT ADDRESS OUTPUT DATA INPUT DATA	In LAMP TEST position, applies +5 Vdc to light all indicators. Other positions select input or output data or addresses to be monitored.
STEP PBI	Momentary	In the test mode, when the RUN/STOP PBI is in the STOP position (not lit) pressing STEP switch transfers one test pattern through memory and advances address counters. Used in test mode only.
RUN/STOP PBI	In Out	In the test mode, the RUN position (indicator lit) allows test patterns to be transferred through memory automatically. Used in test mode only.
PATTERN switch	I O WP	In test mode, selects test pattern to be transferred through memory. Used in test mode only.
ERROR PBI	Momentary	In the test mode, lights to indicate parity error between test patterns at memory input and output, and remains lit until pressed. Used in test mode only.

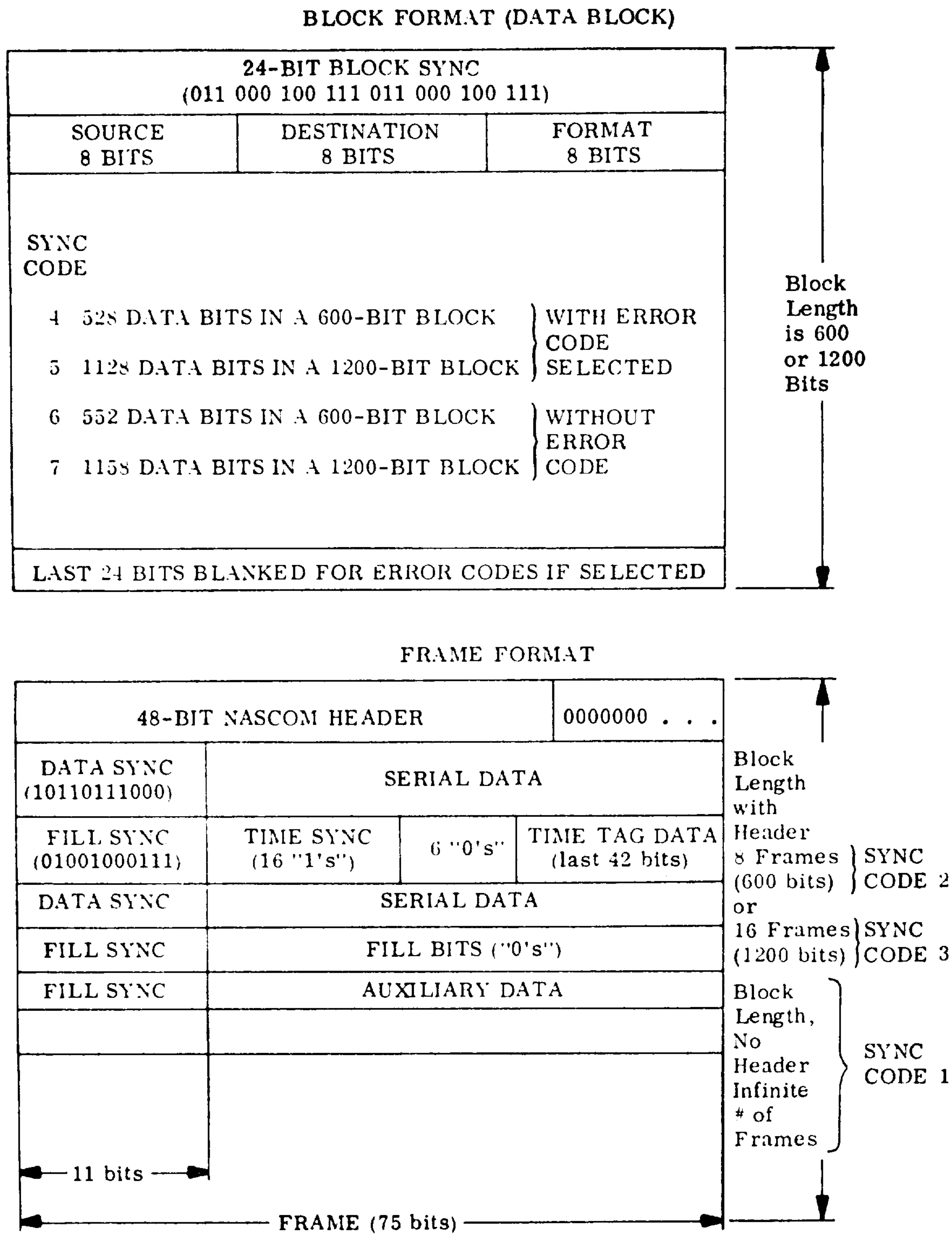


Figure 4-23. Typical Data Transmission System Message Formats

4.5.5 MODEL D114 DECODER

The Model D114 Decoder operates essentially as described in para 4.5.1, but GMT time code is not provided in this unit. An input-output diagram is shown in figure 4-24. Decoder characteristics are listed in table 4-50. Controls and indicators are shown in table 4-51.

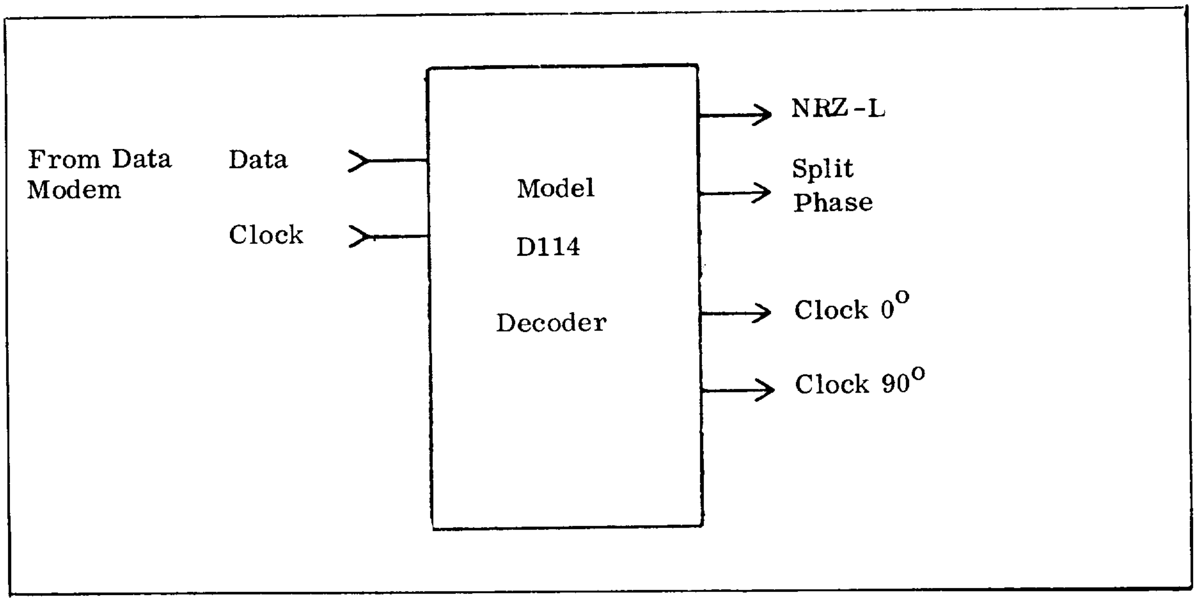


Figure 4-24. Model D114 Decoder Input-output Diagram

Table 4-50. Model D114 Decoder Characteristics

Parameter	Characteristics
Input Signal Requirements	
Format	NRZ-L.
Frequency (Data and Clock)	Normally 7.2 kb/sec (20-kb/sec max).
Modem Data and Clock Logic	One (-6 Vdc); Zero (+6 Vdc).
Minimum Pulse Width	25 nsec.
Output Signals	
Data Format	NRZ-L and split-phase.
Clock Format	NRZ-L.
Data and Clock Frequency	Same as remote encoder input (20-kb/sec max).
Data and Clock Logic	One (-9 Vdc); Zero (+9 Vdc).
Clock Phase	0 degree and 90 degrees.

Table 4-51. Model D114 Decoder Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
AC POWER switch	ON OFF	Applies ac power to decoder and power supply.
AC POWER indicator		Lights when power switch is in the ON position.
DATA FROM MODEM indicator		Lights during 1 transition in data, fill, or overhead.
VCO FREQUENCY switches	0 - 9	Switch settings determine output bit rate.
BLOCK SEARCH indicator		Lights when system is out of block sync and in block search mode.
FRAME SEARCH PBI	Momentary	Lights when system is out of frame lock and in frame search mode. When pressed to light, interrupts frame and block lock and puts system in search mode.
BLOCK LOCK indicator		Lights when block counter is in sync and decoder is locked on header sync pattern.
FRAME LOCK indicator		Lights when frame counter is in sync and decoder is locked on data and fill sync patterns.
DATA PRESENT indicator		Lights when serial data is being received by the system.
DATA PRESENT switch	ON OFF	When set to ON, allows flow of data through memory to the output.
MEMORY ERROR EMPTY PBI	Momentary	Lights when memory is empty, and remains lighted until pressed. Indicator extinguished.
MEMORY ERROR FULL PBI	Momentary	Lights when memory is full, and remains lighted until pressed. Indicator extinguished.
DATA BITS/ADDRESS PBI		During normal operation only the indicators are used; these display a binary number which indicates the number of 8-bit words in memory. In the monitor mode (MONITOR indicator lighted), the indicators monitor memory input and output data and addresses as determined by settings of SYSTEM TEST switches. Not used during data decoding.

Table 4-51. Model D114 Decoder Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
DATA BITS/ADDRESS BITS PBI (cont)		In the test mode (TEST switch lighted), the pushbuttons may be used to preset the input and output address registers as determined by settings of SYSTEM TEST switches.
SYSTEM TEST MONITOR PBI	Momentary	When lit, allows the use of DATA BITS/ADDRESS BITS indicators to monitor memory input and output data and output addresses as determined by settings of SYSTEM TEST switches. Indicator lights when in monitor mode.
DATA PBI	Momentary	When lit, selects the input or output data register for test as determined by settings of INPUT and OUTPUT PBI's. Indicator lights when pushbutton is pressed.
ENABLE PB		When pressed in test mode, causes memory read-in or read-out as determined by settings of INPUT and OUTPUT PBI's.
ADDRESS PBI	Momentary	When lit, selects the input or output address register for test as determined by settings of INPUT and OUTPUT PBI's. Indicator lights when pushbutton is pressed.
OUTPUT PBI	Momentary	When lit, selects the output data or address register for test as determined by settings of ADDRESS and DATA PBI's. Indicator lights when pushbutton is pressed.
CLEAR PB	Momentary	When pressed in test mode, clears data and address registers.
INPUT PBI		When lit, selects the input data or address register for test as determined by settings of ADDRESS and DATA PBI's. Indicator lights when pushbutton is pressed.
TEST PBI		In TEST position (indicator lighted), allows the use of DATA BITS/ADDRESS BITS PBI's to preset the input data register and input and output address registers.

4.5.6 DUPLEX DIGITAL DATA FORMATTER

4.5.6.1 General

a. The Duplex Digital Data Formatter (DDDF) is a system capable of multiplexing, demultiplexing, and formatting multiple digital inputs routed to and from a station by means of synchronous communication circuits.

b. The DDDF consists of two sections: encoder and decoder. The encoder section has six input channels which will accept serial or parallel data, format the data, and transmit it to an output modem under control of the modem clock. The input channels also have the capacity to attach a time tag to parallel input data. The decoder section will accept data and clock from the receive portion of the modem, acquire synchronization, and output the data to station equipment via the six output channels.

c. Characteristics for the DDDF are listed in table 4-52 and table 4-53 lists front-panel control functions.

Table 4-52. DDDF Equipment Characteristics

Parameter	Characteristics
Encoder	
Format	NRZ-L.
Frequency/Channel	Sum of the six input channels not to exceed data clock rate less 15 percent.
Minimum pulse width	25 nsec.
Inputs	
Data and Clock Levels	
Logic 1	+4.5 ±1.5 V.
Logic 0	0 ±0.5 V.
Data Modem Clock Level	
Logic 1	-20 V max.
Logic 0	+20 V max.
Data Modem Control Level	
Logic 1	+20 V max.
Logic 0	-20 V max.
Outputs	
Data Level	
Logic 1	-8 V.
Logic 0	+8 V.
Modem Clock Rate	Up to 230.4 kb/sec.

Table 4-52. DDDF Equipment Characteristics (cont)

Parameter	Characteristics
Decoder	
Inputs	
Modem Clock Rate	Up to 230.4 kb/sec.
Data Level	
Logic 1	-8 V.
Logic 0	+8 V.
Outputs	
Format	1. NRZ-L, gated serial data at the modem clock rate. 2. Sixteen-bit parallel words.
Frequency/Channel	Sum of the six output channels not to exceed data modem clock rate less 15 percent.
Data and Clock Levels	
Logic 1	+3.6 to 4.4 V.
Logic 0	0.0 V nominal.

Table 4-53. DDDF Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
MODEM READY indicator		Encoder Mode Lights when clear-to-send signal is present. Decoder Mode Not lit.
DATA OUTPUT indicator		Encoder Mode Lights during each 0 in output data stream. Decoder Mode Not lit.
CHANNEL display		Encoder/Decoder Mode One digit display which indicates the number of the channel selected by CHANNEL switch.
SOURCE display		Encoder Mode Blanked out. Decoder Mode Three-digit octal display which indicates source of data for channel selected by CHANNEL switch.
FORMAT display		Encoder Mode Three-digit display which indicates stored format (1 through 63) for channel indicated by CHANNEL switch. Decoder Mode Displays actual data format on channel selected.
ON indicator		Encoder Mode Indicates that channel corresponding to channel selected has been turned on. Decoder Mode Always lit.
TEST indicator		Encoder/Decoder Mode Indicates channel corresponding to channel selected has been enabled for testing.

Table 4-53. DDDF Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
DATA indicator		<u>Encoder Mode</u> Indicates data coming into input register from data source. <u>Decoder Mode</u> Indicates presence of data block in specified channel.
ERROR indicator		<u>Encoder Mode</u> Indicates an overflow condition on the channel selected. <u>Decoder Mode</u> In the test mode only, indicates a loss of comparison in the channel being tested.
DECODER ALARM indicator		<u>Encoder Mode</u> Not lit. <u>Decoder Mode</u> Provides visual warning when no format has been recognized by decoder or a test failure when the decoder is in the test condition.
ENCODER ALARM indicator		<u>Encoder Mode</u> Provides visual warning when modem clear-to-send signal is absent or when any channel is in an overflow condition. <u>Decoder Mode</u> Not lit.
DISABLE/RESET switch		<u>Center</u> Enables visual and audible alarm circuit.
	DISABLE	Disables audible alarm circuit.
	RESET	Resets visual and audible latching circuit after a clear-to-send failure. Can be reset only by cycling the failed channel off, then on again.

Table 4-53. DDDF Front-panel Controls, Indicators, and Nominal Settings (cont)

Switch/Control	Position	Purpose
Audible alarm		Encoder/Decoder Modes Provides audible warning when modem clear-to-send signal is absent or when any channel is in an overflow condition or test failure, when system is in the test condition, or when decoder format is not recognized.
ENTER switch	Momentary	Encoder Mode When set and released, causes clock pulse which performs functions as determined by setting of CHANNEL and FUNCTION switches. Decoder Mode Toggles channel on and off.
▼ FORMAT thumbwheel switches (3)	8-position	Encoder Mode Selects one of 63 formats which may be stored in memory for selected channel. Decoder Mode Sets up actual data format portion of field which will be decoded for routing.
FUNCTION switch	ON/OFF	Encoder Mode Pressing ENTER switch activates channel selected by CHANNEL switch and causes ON indicator to light. Pressing ENTER switch a second time deactivates the selected channel and causes ON indicator to extinguish. Decoder Mode The channels are always on and the ON indicator is lighted.
	TEST	Encoder/Decoder Modes Pressing ENTER switch applies output of test pattern generator to channel selected by CHANNEL switch and causes TEST indicator to light.

▼ Specified in NOSP.

Table 4-53. DDDF Front-panel Controls, Indicators, and Nominal Settings (cont)

Switch/Control	Position	Purpose
FUNCTION switch (cont)	STORED FORMAT	Encoder Mode Selects the number of the format that is stored in the ROM for the channel selected. The information contained in the ROM is transferred to the RAM when ENTER switch is pressed. Decoder Mode STORED FORMAT is the 8-bit data format portion of the routing leader that is used by the decoder for routing of the received data.
	PREPASS	Encoder/Decoder Modes Sends abbreviated ID block for the channel selected.
	POSTPASS	Encoder/Decoder Modes Sends abbreviated summary block for the channel selected.
CHANNEL switch	0	Encoder/Decoder Modes Pressing the ENTER switch initializes the system.
	1 through 6	Encoder/Decoder Modes Selects channel which is controlled by ENTER switch. Selected channel is displayed on CHANNEL display.
	7	Encoder/Decoder Modes Pressing the ENTER switch controls the paper tape reader.
ENCODER/DECODER switch	ENCODER	Selects encoder operation.
	DECODER	Selects decoder operation.
BLOCK indicator		Encoder Mode No function. Decoder Mode Lights to indicate NASCOM Sync has been recognized and a data block has been received or decoder portion has decoded NASCOM Sync (first 24 bits).

Table 4-53. DDDF Front-panel Controls, Indicators, and Nominal Settings (cont)

Switch/Control	Position	Purpose
DATA FROM MEMORY indicator		<u>Encoder Mode</u> No function. <u>Decoder Mode</u> Lights during each 1 in input data stream.

4.5.6.2 Encoder. The encoder portion of the DDDF consists of input channels, time interface buffers, a format section, and an output interface. There are six input channels, each having the capability to operate in a serial or parallel mode. In the parallel mode, the channel accepts words of 16 bits in length plus four status or control bits including frame sync lock and frame sync recognition. Each channel will time tag data upon receipt of an external time tag pulse while operating in the parallel mode. In the serial mode, the channels route the serial input data directly to the input channel buffers. No time tag is provided in the serial mode. Channels are completely independent from one another; e.g., channels 1 and 4 may be operating in the parallel mode while channels 2, 3, 5, and 6 may be operating in the serial mode. Figure 4-25 is a block diagram of the DDDF encoder.

a. Modes of Operation

(1) Parallel Mode. Each of the six input channels is capable of accepting words up to 20 bits in length, at times designated by an external read pulse. Bits 1 to 16 consist of data bits while bits 17 to 20 are data flags. Bits 1 to 16 will be transferred to the input channel in succession. The flag bits will be entered in the time tag and flag field. Figure 4-26 shows the time tag field. Each parallel channel has the capability to intersperse a time reading at selected points in the parallel data. The time information available from a BCD-to-binary converter consists of 38-bit parallel data: 9-bit day of year, 27-bit msec of day, and two parity bits.

(2) Block Resynchronization Constant Mode. Generally, telemetry data is packed in the data portion of the DDPS blocks; i.e., the entire 1072-bit data field contains spacecraft telemetry data. However, in some instances it is desirable to have the first data word of the spacecraft telemetry frame appear as the first data word of the DDPS block. Thus, some means of periodic resynchronization is necessary. This is accomplished by the Block Resynchronization Constant (BRC), which is predetermined for a particular satellite bit stream and stored in the format section of the DDDF along with the other setup parameters for that spacecraft. The BRC is the number of spacecraft telemetry frames which occur before resynchronization, and may not exceed 1072 frames. The BRC for packed data is 0. When resynchronization occurs, the remainder of the data portion of the DDPS block is filled with an octal 311 pattern. Because of internal timing considerations, the maximum number of 311 fill patterns that can be added by the DDDF is 10.

(3) Serial Mode. Each of the six input channels has the capability to accept serial NRZ-L input data and a synchronous clock and transfer these to the input channel buffers. No time tagging is done in the serial mode. Each input channel has three input buffers. Each input buffer has a data capacity of 1072 bits. One of the buffers accepts data from its input channel until it has stored 1072 bits, and then switches to one of the other buffers and generates a flag to advise the format section that a buffer is ready to be emptied. Before the second and third buffers have been filled, the format section empties the first buffer, so that the data input can then be switched back to that buffer. Under normal operating conditions, the format section always services the input channel buffers in a manner to prevent overload of any channel. "Normal operating conditions" implies that the sum of the bit rates of the six input channels, plus overhead, will not exceed the maximum available output bandwidth. Table 4-54 shows the DDDF DDPS serial formatting.

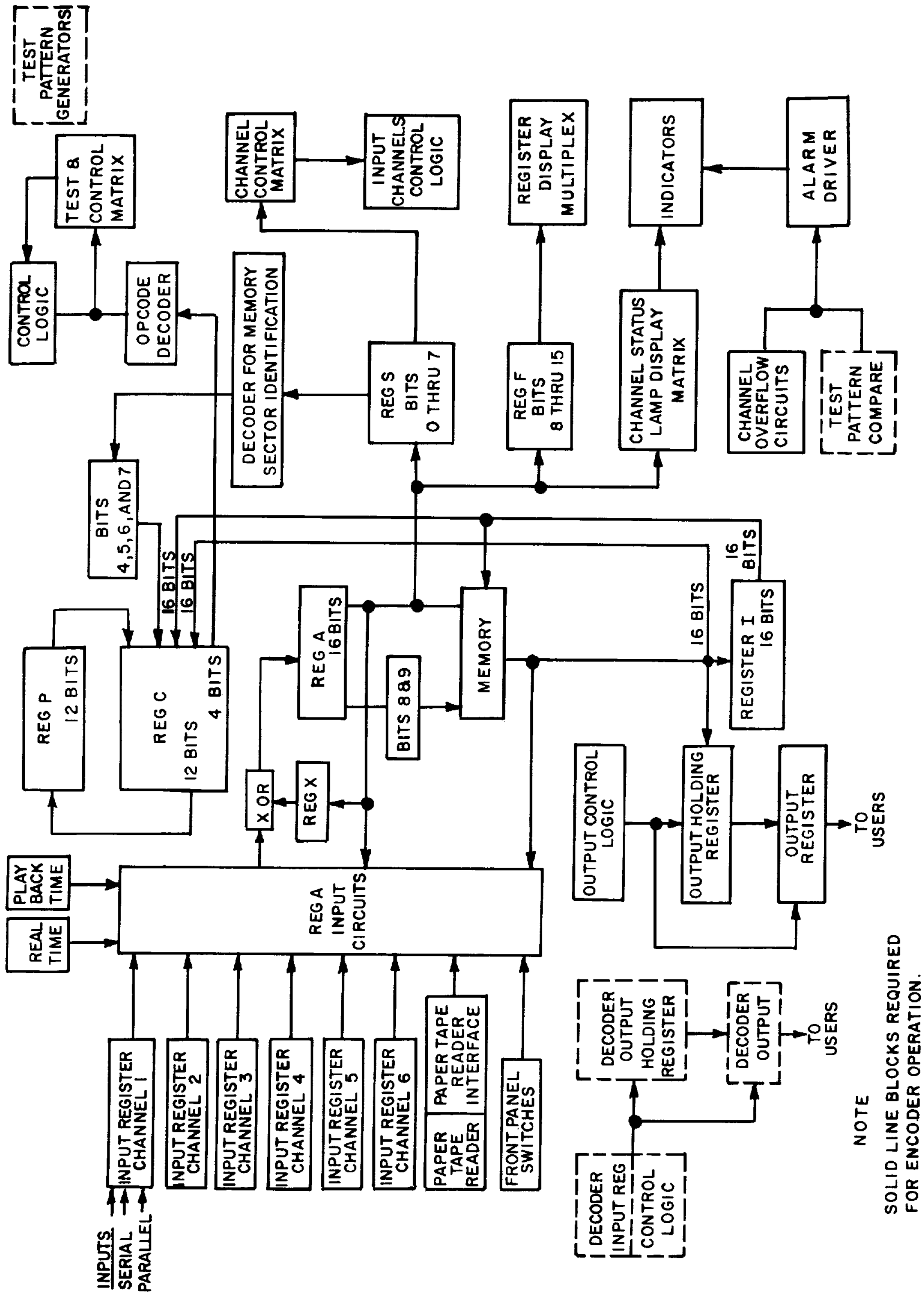
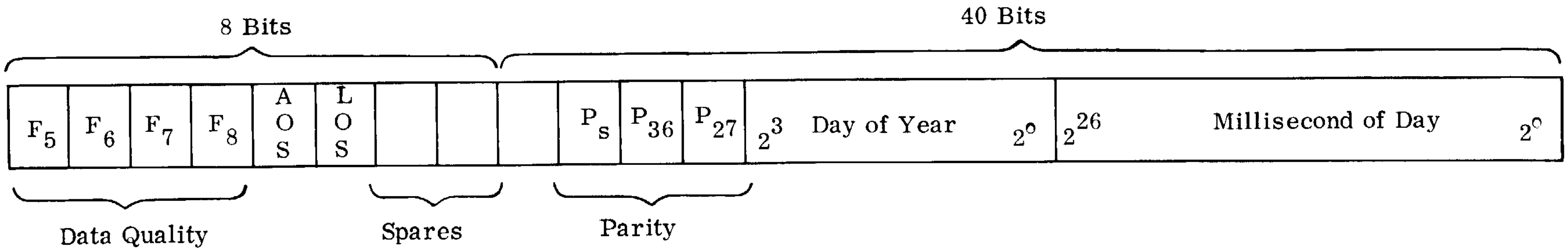


Figure 4-25. DDDF Encoder Functional Block Diagram



Note

1. The time tag field is interspersed at selected points in parallel data.
2. Sample taken when called for by frame sync flag bit, the flag bit less than 500 nanoseconds duration.
3. The flag bit occurs in conjunction with external read pulse which transfers parallel word to input channel.
4. Time sample inserted in bit stream after parallel word received at same time as the time tag flag.
5. Time sample must be transferred into buffer before the next external read pulse occurs.
6. All input channels capable of simultaneous time tag in either real time or playback.
7. Data quality flag bits:

   F5 = 1. Current frame detected bit slippage.

   F6 = 1. Previously lost data.

   F7 = 1. Current FSW has one or more bit errors.

   F8 = 1. Frame sync not recognized (flywheel mode).

Figure 4-26. Time and Tag Field Diagram

Table 4-54. DDDF DDPS Serial Formatting

Item	Data	No. of Bits	Bit Position	Format
a	NASCOM Sync 011000100111011000100111 MSB LSB (MSB transmitted first)	24	1 - 24	Binary
b	Source Code (Constant for given station)	8	25 - 32	Binary
c	Destination Code	8	33 - 40	Binary
d	Data Format (A variable tells where the data is coming from; used by the DDDF decoder to route the received data.)	8	41 - 48	Binary
e	SC ID	4	49 - 52	
f	Message ID (Sequential binary number.)	12	53 - 64	Binary
g	Message Type	4	65 - 68	Binary
h	Message Subtype	4	69 - 72	Binary
i	F_1 (Set to 1 if last block of message; summary block.)	1	73	Binary
j	F_2 (Set to 1 if first block of message; ID block.)	1	74	Binary
k	F_3 (Set to 1 if retransmitted block.) Always 0 as DDDF has no retransmission capability.	1	75	Binary
l	F_4 (Set to 1 if block is to be acknowledged.) Always 0 as DDDF has no acknowledgement capability.	1	76	Binary
m	Message Block Count (Sequenced from start of message.)	20	77 - 96	Binary
n	Data	1072	97 - 1168	-
o	Spare (Will be 0 in the DDDF.)	1	1169	Binary

Table 4-54. DDDF DDPS Serial Formatting (cont)

Item	Data	No. of Bits	Bit Position	Format
p	Block Sequence Count	7	1170-1176	Binary
q	PED Flag F11	1	1177	Binary
r	PED Flag F12	1	1178	Binary
s	Error Check Bits	22	1179 - 1200	-

Note

1. Items a through d are referenced as the NASCOM header.
2. Items e through m are referenced as the message header.

b. Manual Formatting. The header information is operator-selected before processing of data on a channel begins. The system has the capability to set up any unused channel while other channels are in use. Setup of a channel consists of selection of desired stored format, turning the channel off or on, selecting test mode for the channel, etc.

c. Formatting Storage. The DDDF has the capability to store 64 different channel configuration formats internally in such a fashion as to be readily available for channel setup. The formats are preprogrammed and stored in a Read-only Memory (ROM). Parameters set up by selection of a particular stored format are as follows:

(1) The appropriate NASCOM header and message header.

(2) Selection of parallel or serial operation for the input channel selected.

(3) Selection of real time or playback to be used in time tagging of parallel data.

(4) Selection of the resynchronization constant.

d. Channel Priority. Priority of inputs selected for transmission is hardwired, i.e., channel 1 has the highest priority, channel 2 second priority, etc. Data is formatted into blocks for transmission and the system scans the priorities, beginning with channel 1. If an overflow condition exists (the sum of the input bit rates plus overhead exceeds the output bit rate), two blocks of the lowest order priority data are dropped from transmission and an overflow alarm given. The lowest order priority will restart its transmission automatically but will continue to drop two blocks every time the overflow condition exists.

4.5.6.3 Decoder

a. General. The decoder portion of the DDDF will accept serial data and clock from the receive modem at rates up to 10 kb/sec. The system will recognize and remove sync and formatting information, route the data to the six output channels, and output the data in either parallel or serial format, as desired. The decoder requires a perfect 24-bit NASCOM sync word. Figure 4-27 is the decoder block diagram. The decoder operates asynchronously. After synchronization is achieved, the system recognizes the 8-bit data format code and transfers the data to the appropriate output channel of the DDDF decoder. The desired data format code is preselected via front-panel digiswitches. Both the 8-bit source and 8-bit data format portion of the NASCOM header are decoded and displayed; however, only the 8-bit data format is used to route the data to the output channel. No errors are permitted in data format.

b. Output Modes. Each output channel of the decoder has three modes which are available simultaneously.

(1) Gated Serial Output. In this mode, the channel outputs the entire 1200-bit block in the form of gated NRZ-L data with a similarly gated clock. A 0-degree clock is provided for each output channel.

(2) 1072 Gate. Each channel is provided with a 1072 gate. This gate may be AND'ed with the clock for that channel so that only the data portion of the DDPS block will be clocked out of the channel.

(3) Parallel Output. In the parallel output mode, the system shifts the asynchronous serial data into a 16-bit parallel register, generates a parallel word strobe pulse, and outputs the data in 16-bit words. A start-of-block pulse is also provided each channel; this pulse occurs one modem clock pulse before the first parallel word strobe of each received block. One modem clock pulse after the first parallel word is stored for output, the entire 1200-bit block (75 sixteen-bit words) is transferred. The 1072 gate may be AND'ed with the parallel word strobe, if desired, so that only the data portion of the block is transferred.

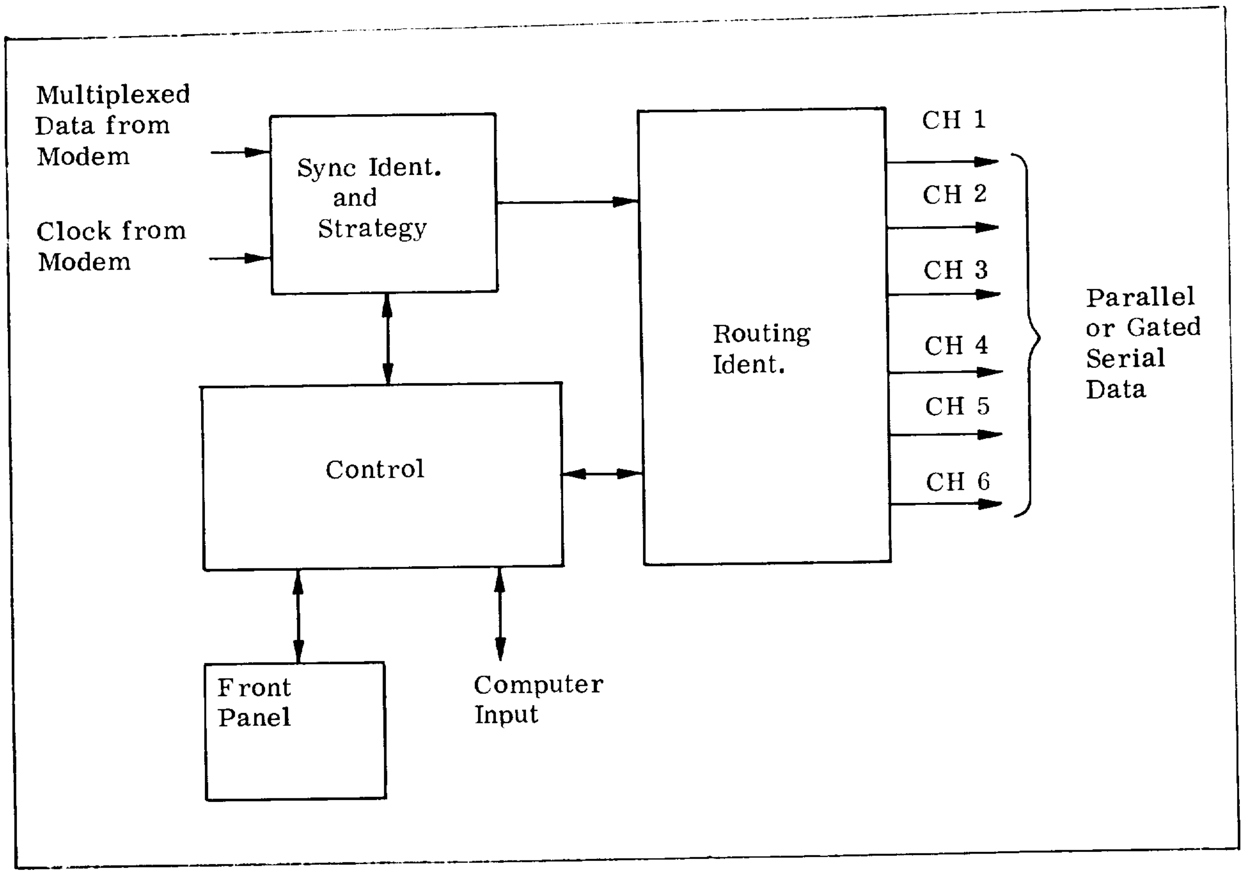


Figure 4-27. DDDF Decoder Block Diagram

4.5.6.4 DDDF Operational Description

a. General

(1) The DDDF is controlled by the front-panel switches. Program inputs and modifications are from paper tape via a Paper Tape Reader (PTR). Loader and test routines are permanent ROM's which control the operation of the front panel and the PTR. In addition to the front-panel switches, there are FORWARD and REVERSE switches on the PTR that must be used when searching for routines on the paper tape prior to loading them. There are three special characters used on the paper tape that are recognized by the PTR, as follows:

Character	Explanation
#	Stop and prepare to go forward.
&	Stop and prepare to continue.
$	Stop and prepare to reverse.

(2) Main routines are between a different set of both of these characters. Once the PTR has been moved forward by the PTR FORWARD switch into the modification routines, an operator must follow specific instructions to guarantee that only the desired routines are entered.

(3) There are two methods of entering data from the PTR. One method requires a reset and enter routine and the second requires that the program be operating. The second method consists of two types of first word patterns that are recognized only if written into the operating program. The first type uses 144711 (16-bit octal pattern) and is used to store the 160 bits of format and identification information required in the ID and summary blocks of a particular satellite. The second type uses 122222 octal for special single word changes and allows program modification while it is actually operating.

b. Definitions

(1) Reset. Dial channel 0 and press ENTER.

(2) Reenter. Select encoder, stored format, any channel other than 0 or 7 (usually channel 1 or channel 6), and press ENTER.

(3) Select Routine (on paper tape). Use the ORWARD or REVERSE pushbuttons on the PTR. Select a channel other than 7 while searching for the routine to prevent incorrect loading.

(4) Store Routine (from paper tape). Select channel 7 and press ENTER.

c. Operation

(1) Loading Program. Select routine M on paper tape, reset, and store routine. If more routines are required for a specific satellite, select, reset, and store each routine required.

The following items in Section 4 have been deleted:

Paragraphs 4.5.6 through 4.5.6.4c(7)

Figures 4-25 through 4-27

Tables 4-52 through 4-54

Pages 4-143 through 4-158

4.6 DATA SYNCHRONIZER SETUP CONTROLLER

4.6.1 DESCRIPTION

4.6.1.1 The Data Synchronizer Setup Controller (DSSC) is a software-controlled system used to provide remote setup of up to 16 data synchronizers. Setup formats may be taken from the DSSC internal memory (LSI-11 computer subsystem), floppy disc, alien computer (PDP-11/20) through the Unibus interface, or may be manually generated from the VT50 keyboard.

4.6.1.2 The Model 453 DSSC with an internal LSI-11 computer subsystem consists of the following: VT50 video terminal keyboard, RXVII dual-drive floppy disc, PDP-11/20 computer, DR11-L output interface, and DR11-M input interface. The DR11-L and DR11-M are between the LSI-11 and PDP-11/20 computer and a cable assembly. A paddleboard is available for interconnecting the DSSC and the DR11-L/-M interfaces. (See figure 4-28.) Normally each data synchronizer consists of a 403 frame synchronizer and a 330 bit synchronizer. At selected stations the capability will exist to have an interface among the DSSC, AMQ, and sequential decoder using the 636/637 level shifter.

4.6.2 SETUP INFORMATION

The software permits selection of 1 to 16 ports to output setup instructions to a particular data synchronizer and to select the source of the information. The setup information may be taken from the memory (LSI-11) internal to the DSSC, from the floppy disc, or from the PDP-11/20. The LSI-11 computer subsystem may, under direction of the VT50 keyboard or PDP-11/20 computer, be loaded with one selected format, with a sequential group of formats, or with a complete 100-format block. Regardless of the format source, all setup data goes through the LSI-11 computer. Refer to table 4-55 for input and output characteristics. See figure 4-29 for format relationship.

4.6.3 HIGH-SPEED DATA FUNCTION

When not providing setup instructions for peripheral equipment, the DSSC is available for monitoring and verifying three DDPS High-speed Data (HSD) lines during any data flow test, Link Readiness Test (LRT), Project Readiness Test (PRT), command test, or tracking test. Three input/output units provide the DSSC with access to the three NASCOM-formatted serial outputs of the DDPS communications processor. The three units accept all data which has been formatted in NASCOM blocks for transmission off station via NASCOM HSD lines. The blocked data is converted from serial to parallel and input to the microprocessor bus via Direct Memory Access (DMA) parallel drivers. The microprocessor receives the data via the bus and processes the data for display in support of fault detection and isolation activities.

4.6.4 OPERATION

4.6.4.1 Model 453 System. To operate the Model 453 system, the operator performs the necessary initialization for hardware and software (exact procedures depend on the mode of operation). In alien (prime) mode, operation is under complete control of the alien computer (PDP-11/20) and the operator cannot verify or modify operating procedures. In console (backup) mode, the VT50 keyboard terminal provides two-way communication between the operator and the software program stored in the LSI-11 computer. The operator can examine and modify data on request.

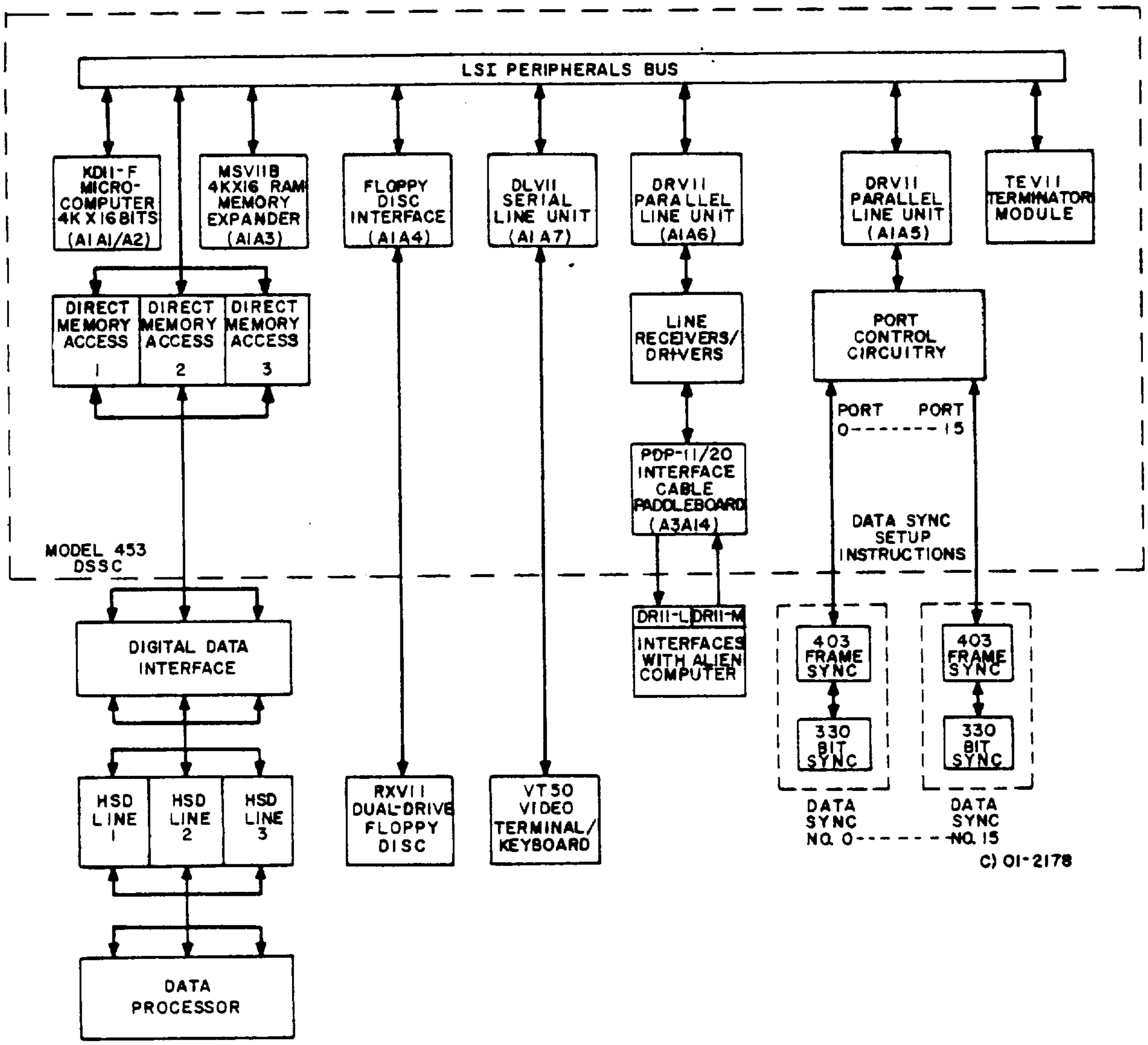
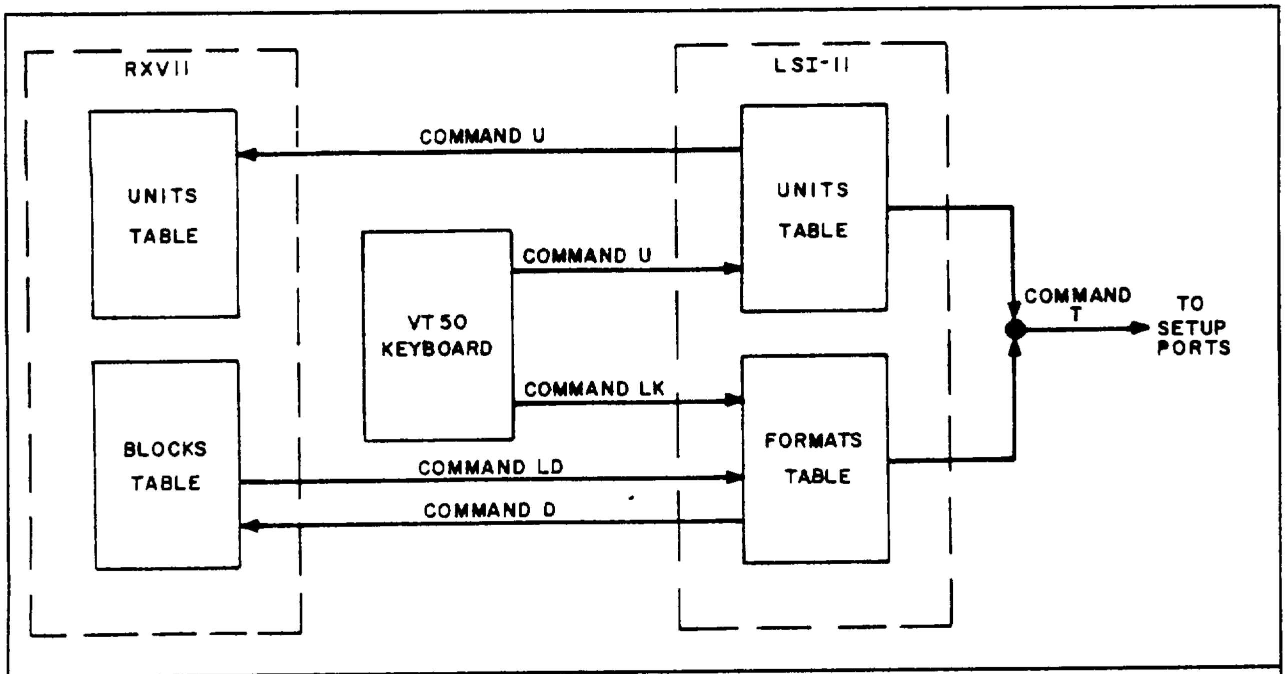


Figure 4-28. Model 453 DSSC Simplified Block Diagram

Table 4-55. Input and Output Characteristics

Data Type	Parallel Digital Information	
Input Characteristics		
Data Composition Each Transmission	One 16-bit control word 20 setup data transfers, consisting of: 16 frame sync setup words 4 bit sync setup words	
Control Word	Setup format ID No. Setup function select Port address Command cycle Control bit	7 bits 1 bit 4 bits 3 bits 1 bit
Setup Word	Setup parameter Function number Frame/bit sync	8 bits 4 bits 1 bit
Signal Level Logic 1 Logic 0	 +6.0 ±2.0 V 0.0 ± 0.25 V	
Acknowledge Strobe	500 nsec wide	
Input Impedance	130 ohms	
Output Characteristics		
Output (each port) 1 Setup Strobe	 500 nsec wide	
16 Data Bits	Setup parameters Function number Unit address	8 bits 4 bits 4 bits
Output 1	130 ohms	



Command	Function
D	Dumping of LSI-11 formats table to RXVII blocks table.
LD	Loading of LSI-11 formats table from RXVII blocks table
LK	Loading/modification of LSI-11 formats table from keyboard.
T	Transmission of LSI-11 formats and units table to setup ports.
U	Loading/modification of LSI-11 units table from keyboard and dumping of LSI=11 units table to RXVII units table

Figure 4-29. Relationship of Setup Format Tables

4.6.4.2 Operating Modes. The DSSC has six possible operating modes as follows:

a. Console Mode. This mode enables keyboard commands to come from the VT50 terminal for manual transmission of any setup format from the DSSC memory to any of the 16 data synchronizers.

b. Remote Console Mode. This mode enables the use of a VT50 terminal at a remote location. The capability for this mode is available but is not used.

c. Alien Computer Mode. The DSSC accepts command words and formats from the external computer (PDP-11/20) for transmission of setup information to the data synchronizers. This mode is initiated by instructions entered on the VT50 keyboard.

d. Test Cycle Mode. Setup information is continuously transmitted to a selected data synchronizer. The information is repeated until stopped by a keyboard command.

e. Test Step Mode. Setup information is transmitted one word at a time to a selected data synchronizer. A keyboard command is required for the transmission of each word.

f. Test Burst Mode. Each keyboard command sends all 20 setup parameter words of the selected format to the specified data synchronizer.

4.6.4.3 Commands. Commands for controlling operation of the DSSC are entered through the VT50 keyboard. The commands are capable of performing the following functions:

a. Controlling setup data transmission from the LSI-11 memory to the data synchronizers.

b. Allowing the operator to enter new formats into the LSI-11 memory.

c. Allowing the operator to examine and modify formats in the LSI-11 memory.

d. Enabling a two-way exchange of setup data between the LSI-11 and RXVII memories.

e. Allowing reinitialization of the system, as required.

Each of seven basic commands has a single-letter designator which is typed to call it. Refer to table 4-56 for the seven commands and designators.

4.6.4.4 VT50 Keyboard Characters. Table 4-57 lists the most commonly used VT50 keyboard characters and their functions. Table 4-58 indicates permissible operating parameters. Refer to table 4-59 for a list of front-panel controls and nominal settings.

Table 4-56. Basic DSSC Commands

Mnemonic	Meaning	Description
A	Alien Mode	Program exits from console mode and enters alien mode.
B	Bootstrap	Bootstraps the system.
C	Console Switch	Switches master/slave status when two VT50 units are used.
D	Dump	Dumps the LSI-11 formats table into the RXV11 blocks table.
L	Load	Loads the LSI-11 formats table from the RXV11 blocks table for the VT50 keyboard.
T	Transmit	Transmits setup data from the LSI-11 formats table to a setup port.
U	Unit Change	Changes the address of either the frame synchronizer or bit synchronizer associated with a particular setup port.

Table 4-57. Common VT50 Keyboard Characters

Character	Function
A	Alien mode command. When a D or L command parameter, signifies dump or load all formats.
B	Bootstrap command. When a T command parameter, signifies burst type transmission.
C	Console switch command. When a T command parameter, signifies cyclic type transmission.
S	When a T command parameter, signifies step type transmission.
T	Transmit command. When a D or L command parameter, signifies to dump or load a contiguous group of formats.
U	Unit change command.

Character	Function
Y	Yes: Used when a positive response to a question displayed on the VT50 CRT is desired.
/ (slash)	SHIFT/? key: An ODT command used to open a memory location, a General Purpose Register (GPR), or a processor status word. The / command normally is preceded by a location identifier.
∧ (caret)	SHIFT/6 key: An ODT command used to close an open location or GPR. If the command is entered after a location or GPR has been opened, it will close it and open the next location, GPR-2 or GPR-1. If the contents of the opened location or GPR are to be modified, the new contents should precede the ∧ operator. In the Load from Keyboard (LK) mode, the ∧ command is used to display and, if desired, modify each preceding word, starting with the one specified by the second parameter in the LK command.
@	SHIFT/2 key: An ODT command that enables the contents of an opened location to be used as a pointer to open a new location. Contents of the originally opened location may be modified and, if modified, the new contents will serve as the pointer.
_ (underline)	SHIFT/-(minus) key: An ODT command used when a location has been opened. It combines the address of the open location, plus the contents of the open location, plus two, to form a pointer to open a new location.
CR	Carriage return: Terminator used to close an open location. If contents of location are to be changed, CR should be preceded by new contents. CR without a value will close a location without altering contents.
D	Dump command. When an L command parameter, signifies to load from disc.
DELETE	Enables correction by deleting last digit entered. May be used in ODT or normal DSSC programming.
G	Go: An ODT command that initiates execution of the program stored at the memory location typed immediately before the G.

Table 4-57. Common VT50 Keyboard Characters (cont)

Character	Function
J	An L command parameter that signifies the jump function.
K	The VT50 terminal keyboard.
L	Load command. An ODT command that will cause the system to hang. The console ODT mode may be restored by momentarily asserting the BDCOK-H signal low, or by cycling the power off and then on.
LF	Line Feed: Used to close an open location or GPR. If entered after a location has been opened, it will close the open location or GPR, and open location +2 or GPR +1. If the contents of the open location are to be modified, the new contents should precede the LF operator.
M	Maintenance: An ODT command used for maintenance purposes; it displays the contents of an internal Central Processing Unit (CPU) register. The data reflects the procedure used to enter the console mode.
N	No: Used when a negative response to a question displayed on the VT50 CRT is desired.
P	Proceed: An ODT command used to continue or resume execution at the location indicated by the current contents of the PC(R7).
$ or R	ODT commands ($ is SHIFT/4 key): Either command, if followed by a register value of 0 to 7 and the value followed by a / (slash), will allow that specific GPR to be opened. If the register value following the command is replaced by the letter s, the processor status word will be opened.
CTRL-SHIFT-S Keys	An ODT command that is not a normal user command but is primarily intended for manufacturing test purposes. If the operator inadvertantly enters this mode, it may be terminated by entering two characters (such as 0 and @) to specify an address. Once completed, ODT will issue a CR, LF, @.

Table 4-58. Permissible Operating Parameters

Parameter	Range Octal
Frame Synchronizer Number	0 to 17
Bit Synchronizer Number	0 to 17
Setup Port Number	0 to 17
Disc Drive	0 or 1
Block Number	0 to 143
Format Number	0 to 143
Format Word Number	0 to 23
Format Word Value	0 to 377

Table 4-59. Model 453 DSSC Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
ENABLE/HALT	ENABLE HALT	Two-position vertical-throw toggle switch. During normal operation, the switch is set to ENABLE. When set to HALT, the internal KD11-F processor is placed in halt mode, the ODT program is activated, and the Bootstrap program may be entered in the LSI-11 memory.
ON/OFF	ON OFF	Two-position toggle switch. When set to ON, ac power is applied.
DC FAIL 12V	Indicator	Lights when internal power supply PS1 fails.
DC FAIL 5V	Indicator	Lights when internal power supply PS2 fails.
POWER	Indicator	Lights when ac power is being applied to the unit.

4.6.4.5 System Check. To perform a quick check of the Model 453 system, the DSSC/SAV program (supplied on a diskette) should be Bootstrapped into the DSSC as follows:

CAUTION

To prevent the possible loss of information, diskettes should not be in the drive unit when powering up.

a. Power up the system.

b. On the selected disc drive, press the spring-loaded door tab to open the front cover.

c. Insert the diskette containing the desired program with the label side up and oblong slot pointing away from you. Close the door by pushing on the door tab until it catches.

d. On the DSSC unit, set the ENABLE/HALT switch to HALT and the ON/OFF switch to ON.

e. The ODT prompt character @ should be displayed in the left margin of the system terminal. The Bootstrap program that will be keyed is listed in table 4-60 (starting address is location 1000). Using the keyboard, enter 1000/; the current contents of that location will be displayed following the / (slash).

f. Referring to table 4-60, enter the new contents listed for location 1000 (12702).

g. Terminate the line by entering LF. The next sequential address will be displayed and after entering /, the contents of that location will be displayed.

h. Referring to table 4-60, enter the new contents (100247 or 100267) for the address displayed (001002).

i. Terminate the line by entering LF. After the next sequential address is displayed, enter / to display the location contents.

j. Repeat h and i until new contents have been entered for all locations in table 4-60.

k. Terminate the last location line by entering CR. Prompt character @ will appear on the next display line.

l. Verify the Bootstrap by entering the first location in table 4-60 (1000), then entering /. The new contents entered in step f should be displayed.

m. Terminate the line by entering LF. The next sequential address in table 4-60 should be displayed and, after entering a /, the new contents for that location will be displayed.

n. Repeat steps l and m until the new contents of all locations in table 4-60 have been verified. If a discrepancy occurs, go back to step e.

Table 4-60. Bootstrap Program

Location	/	Old Contents	New Contents
1 0 0 0	/	0 0 0 0 0 0	0 1 2 7 0 2 (LF)
0 0 1 0 0 2	/	0 0 0 0 0 0	1 0 0 2 n 7 (LF)
0 0 1 0 0 4	/	0 0 0 0 0 0	0 1 2 7 0 1 (LF)
0 0 1 0 0 6	/	0 0 0 0 0 0	1 7 7 1 7 0 (LF)
0 0 1 0 1 0	/	0 0 0 0 0 0	1 3 0 2 1 1 (LF)
0 0 1 0 1 2	/	0 0 0 0 0 0	0 0 1 7 7 6 (LF)
0 0 1 0 1 4	/	0 0 0 0 0 0	1 1 2 7 0 3 (LF)
0 0 1 0 1 6	/	0 0 0 0 0 0	0 0 0 0 0 7 (LF)
0 0 1 0 2 0	/	0 0 0 0 0 0	0 1 0 1 0 0 (LF)
0 0 1 0 2 2	/	0 0 0 0 0 0	0 1 0 2 2 0 (LF)
0 0 1 0 2 4	/	0 0 0 0 0 0	0 0 0 4 0 2 (LF)
0 0 1 0 2 6	/	0 0 0 0 0 0	0 1 2 7 1 0 (LF)
0 0 1 0 3 0	/	0 0 0 0 0 0	0 0 0 0 0 1 (LF)
0 0 1 0 3 2	/	0 0 0 0 0 0	0 0 6 2 0 3 (LF)
0 0 1 0 3 4	/	0 0 0 0 0 0	1 0 3 4 0 2 (LF)
0 0 1 0 3 6	/	0 0 0 0 0 0	1 1 2 7 1 1 (LF)
0 0 1 0 4 0	/	0 0 0 0 0 0	1 1 1 0 2 3 (LF)
0 0 1 0 4 2	/	0 0 0 0 0 0	0 3 0 2 1 1 (LF)
0 0 1 0 4 4	/	0 0 0 0 0 0	0 0 1 7 7 6 (LF)
0 0 1 0 4 6	/	0 0 0 0 0 0	1 0 0 7 5 6 (LF)
0 0 1 0 5 0	/	0 0 0 0 0 0	1 0 3 7 6 6 (LF)
0 0 1 0 5 2	/	0 0 0 0 0 0	1 0 5 7 1 1 (LF)
0 0 1 0 5 4	/	0 0 0 0 0 0	1 0 0 7 7 1 (LF)
0 0 1 0 5 6	/	0 0 0 0 0 0	0 0 5 0 0 0 (LF)
0 0 1 0 6 0	/	0 0 0 0 0 0	0 2 2 7 1 0 (LF)
0 0 1 0 6 2	/	0 0 0 0 0 0	0 0 0 2 4 0 (LF)
0 0 1 0 6 4	/	0 0 0 0 0 0	0 0 1 3 4 7 (LF)
0 0 1 0 6 6	/	0 0 0 0 0 0	1 2 2 7 0 2 (LF)
0 0 1 0 7 0	/	0 0 0 0 0 0	0 0 0 2 4 7 (LF)
0 0 1 0 7 2	/	0 0 0 0 0 0	0 0 5 5 0 0 (LF)
0 0 1 0 7 4	/	0 0 0 0 0 0	0 0 5 0 0 7 (CR)

Note

n = 4 for disk unit 0 (left drive)
n = 6 for disk unit 1 (right drive)

(LF) = Line Feed
(CR) = Carriage Return

Starting Address = 1000

o. Terminate the verification sequence (location 001074) by entering CR. Prompt character @ should appear on the next line.

p. Set the DSSC ENABLE/HALT switch to ENABLE.

q. Enter the Bootstrap start address from table 4-60 followed by the letter G (1000G).

r. The disc drive will audibly engage the diskette and after a delay of approximately 30 seconds, the terminal display should appear as shown in figure 4-30.

s. The system is ready to accept and respond to operator commands.

4.6.5 DSSC SOFTWARE

4.6.5.1 General. DSSC software will be generated and controlled by Code 852.2. The software should be written on the DSSC discs as soon as practical after receipt. A TESOC (STDN No. 515) will be maintained for the DSSC.

4.6.5.2 Sequence Control Number. DSSC software sequence numbers will be from 2000 through 2999. The suffix SC will be used. Sequence numbers will be authorized on the PCM software SSI.

4.6.5.3 Station Software Responsibilities

a. Each station should retain approximately 12 blank floppy discs for use with the DSSC. Each station should maintain a master disc and working copy disc for their DSSC software.

b. DSSC software will be distributed by an OPN message. Format identification will be made by a series of two octal characters, a dash, and three octal characters, e.g., 01-027. The first two characters (00 through 16) specify the block number on the disc in which the software is maintained. The last three characters (000 through 143) indicate which of the 100 formats is within the specified block. It is the responsibility of the stations to ensure that software issued by OPN is written into the specified block and format.

c. All software issued by Code 852.2 should reside in disc blocks 00 through 16. Block 17 is reserved for individual station use to store any locally generated programs. No locally generated programs will be authorized for operational use.

4.6.5.4 Software Improvement Report. Locally generated software may be submitted as a Software Improvement Report (SIR) to Code 852.2.

LINE								
1	0	1	2	3	4	5	6	7
2	a	a	a	a	a	a	a	a
3		b (console)				c (mode)		
4	10	11	12	13	14	15	16	17
5	a	a	a	a	a	a	a	a
6								
7	d							
8								
9								
10								
11								
12								

Note

1. Lines 1 and 4 show setup port numbers in octal.

2. Lines 2 and 5 should all display ? initially, then a three-digit number corresponding to the format last loaded through the associated setup port (should be less than 144).

3. The letter b indicates the console field, which should show either MASTER OR SLAVE.

4. The letter c indicates the mode field, which should show either ALIEN or CONSOLE.

5. The letter d indicates the cursor home position and start of the scrolling buffer field.

6. Lines 7 through 12 are used for operator directives and status messages.

Figure 4-30. Terminal Display for DSSC/SAV Program

4.7 SEQUENTIAL DECODER AND ENCODER SYSTEMS

4.7.1 LS4815 SEQUENTIAL DECODER SYSTEM

4.7.1.1 General

a. Objective. The objective of convolutionally encoding the telemetry data streams is to improve the expanded bit error rate performance of the telemetry channel and to provide an additional signal margin during critical phases of a mission. Typically, the telemetry data stream is encoded onboard the spacecraft prior to transmission. At some point after reception by the ground station, the encoded data is decoded and an image of the original data stream is reconstructed.

b. Description. One system used to decode convolutionally encoded data streams is the LS4815 sequential decoder system which takes its input from a Model 330 PCM bit synchronizer. The system has two outputs: a serial data stream to be input to a PCM decommutator, and a parallel data stream formatted into computer transfers for input to a telemetry data controller or 642B Expanded Memory Unit (EMU) channel. A 403 frame synchronizer provides End-of-frame (EOF) and flag information. Figures 4-31 and 4-32 are block diagrams of the system and table 4-61 lists system characteristics.

4.7.1.2 Operational Considerations

a. Parameters. Table 4-62 lists the front-panel controls. The system is operated by setting a number of parameters either from the front panel in the local mode or automatically in the remote mode. This is done by the DSSC or by the Setup Controller (SUC) on stations not equipped with a DSSC. These parameters will normally be provided by the applicable NOSP.

b. Modes. The sequential decoder has the following basic modes of operation:

(1) Decode

(a) Method. In decode mode, the decoder processes one frame at a time and, in processing a frame, steps through the bits one at a time. For each bit, the decoder decides the corresponding decoded bit value should be. At the same time, it generates an accumulated figure of merit (path metric) which is an indication of the reliability of the decisions made. If the figure of merit falls below a certain value, the decoder steps back through the data searching for a path of decisions in which the figure of merit maintains a satisfactory value. Due to the relationship the encoded bits have to each other, the decoder can correct invalid bits by changing the decision from one bit to another which has a higher figure of merit.

(b) Memory. To allow the decoder to continuously receive serial decode and output data, two memories are provided. One memory holds the frame being input and the frame being decoded; the other memory holds the frame being output. The output memory has a delay equal to the length of one frame. For frame lengths from 256 to 1024 bits, the input memory delays the data by 4 frames; therefore, the total delay of the system is 5 frames plus the delay

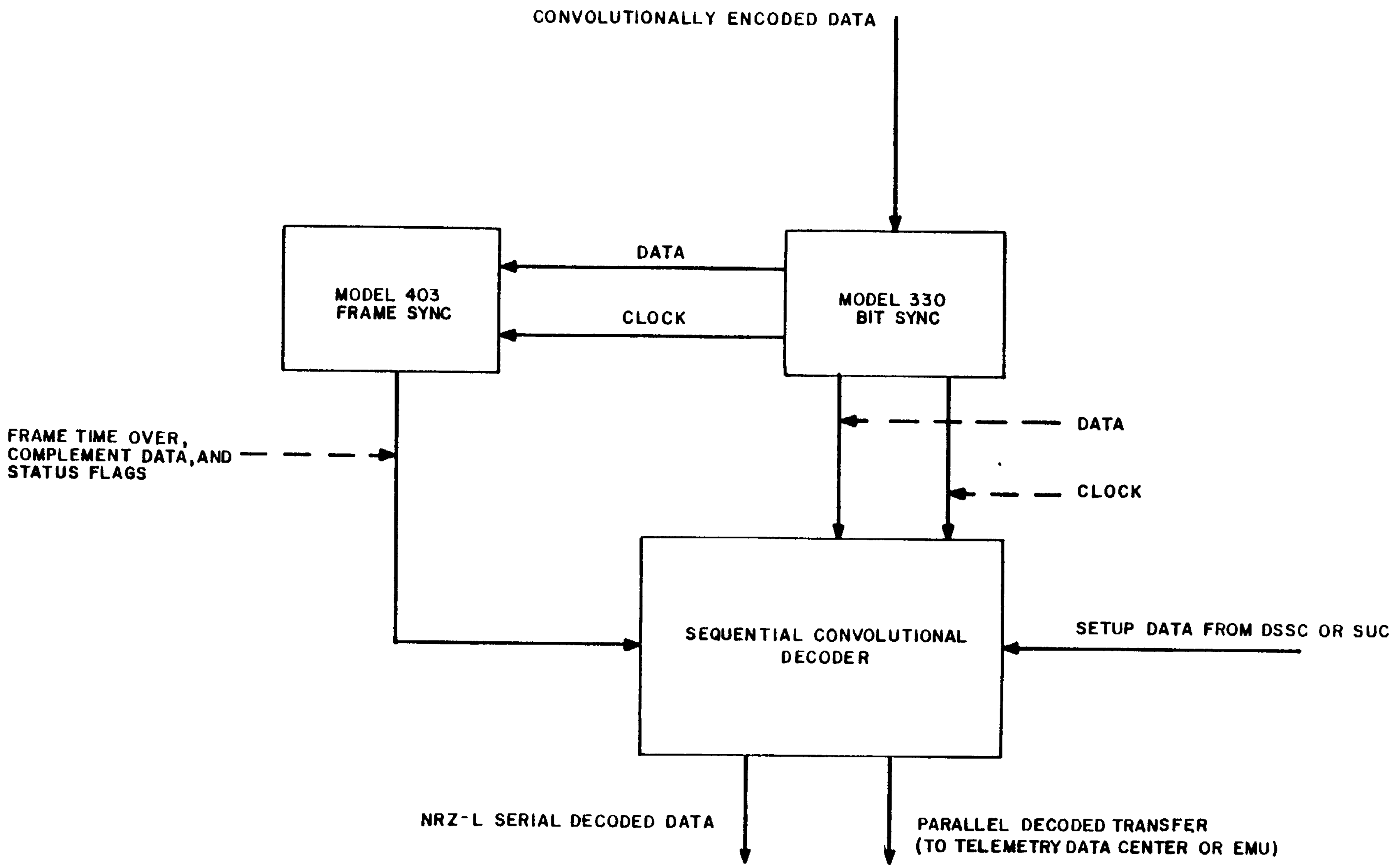


Figure 4-31. Sequential Decoder System Block Diagram (Decode Mode)

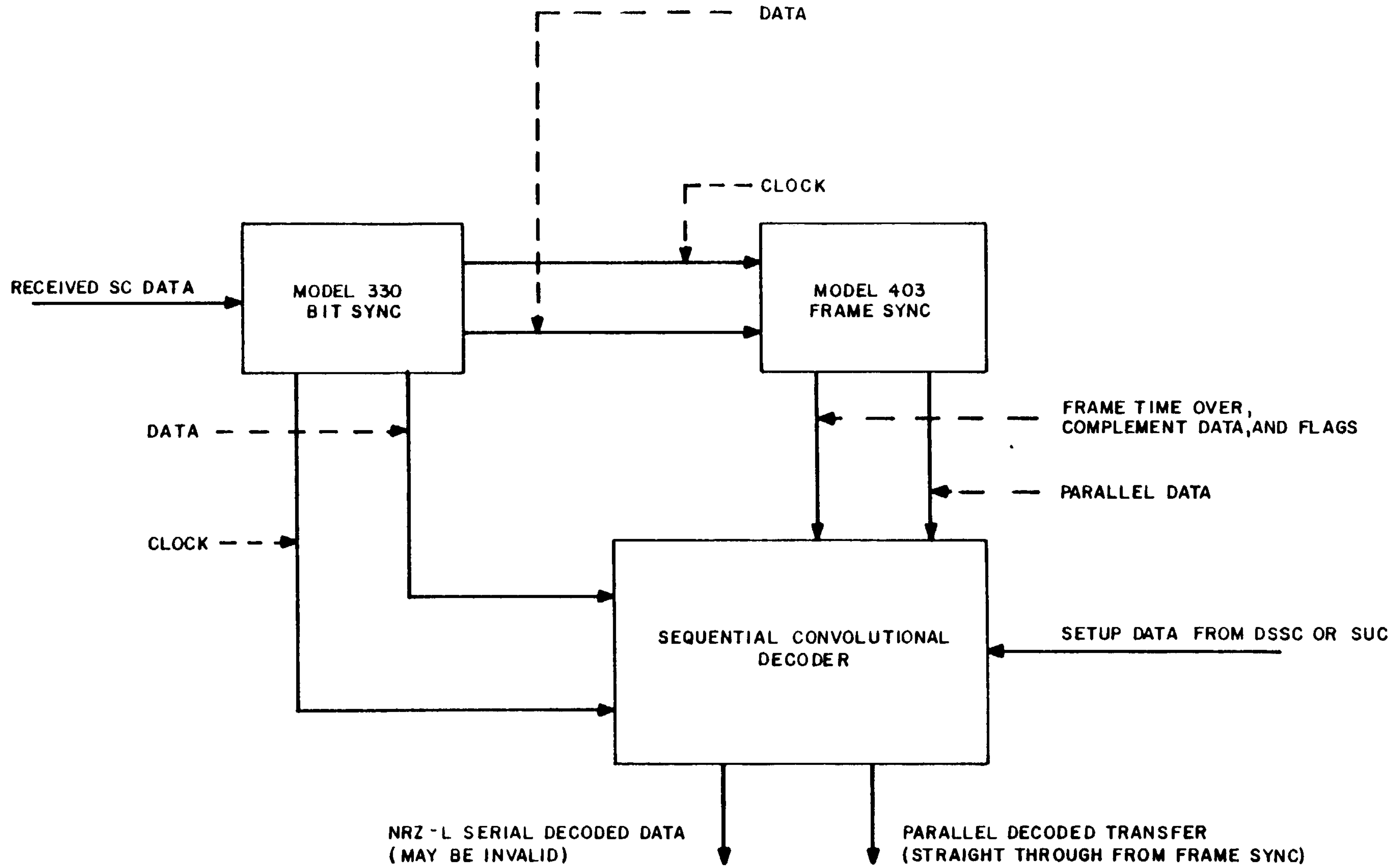


Figure 4-32. Sequential Decoder System Block Diagram (Bypass Mode)

Table 4-61. LS4815 Sequential Decoder System Characteristics

Parameter	Characteristic
Input Power Requirements	105 to 125 Vac, 47 to 63 Hz, 1 phase
Input Power Consumption	0.85 A typical
Input Power Filtering	Both ac lines Electromagnetic Interference (EMI) filtered
Grounding	
Safety Ground	Through ac line cord
Chassis Ground	Direct to safety ground, stud provided
Logic Ground	Independent ground, stud provided
Power Conversion	115 Vac to 5.0 Vdc switching power supply
	115 Vac to 12.0 Vdc series-pass power supply
Operating Temp Range	10 deg C to 40 deg C
Cooling	Fan
Logic Levels (Internal)	0:0 to 0.8 Vdc, 1:1.4 to 5.0 Vdc
Data Frame Length	256 to 2048 information bits
Data Rate	0 to 100 kb/sec information rate
Code Rate	1/2
Code	4 codes: K = 24, 32, 40, 48 Convolutional, quick-look variety
Frame Tail Pattern	Any binary pattern of length K
Decision Mode	3-bit soft or 1-bit hard per channel symbol
Front-panel Representation	Hexadecimal
Computation Rate	1.2288 MHz

Table 4-62. LS4815 Sequential Decoder System Front-panel Controls

Control/Indicator	Position	Purpose
POWER PBI	ON	Applies ac power to the unit.
	OFF	
SETUP PARAMETERS		
DATA (Hex LED Displays)		Provides display of setup parameters.
ADDRESS thumbwheels		Selects which parameter is being displayed.
FRAME LENGTH		
FRAME LENGTH thumbwheels		Selects the frame length of the coded input signal.
QUANT	HARD	Conditions unit to accept non-quantized data.
	SOFT	Conditions unit to accept quantized data.
▼ MODE	BYPASS	Bypasses sequential decoding function.
	DECODE	Selects unit to decode encoded data.
SOURCE	REMOTE	Selects the DSSC or SUC as the source of the setup parameters.
	LOCAL	Selects the front-panel controls as the source of the setup parameters.
SELF-TEST		
TESTING indicator		Indicates that unit is conducting a self-test.
PASS indicator		Indicates that unit has successfully completed a self-test.
FAIL indicator		Indicates that unit has failed a self-test.

▼Specified in NOSP.

Table 4-62. LS4815 Sequential Decoder System Front-panel Controls (cont)

Control/Indicator	Position	Purpose
TEST/ON LINE switch	TEST	Selects self-test mode of internal operation.
	ON LINE	Selects normal mode of internal operation.
▼Constraint Length	24 32 40 48	Selects a constraint length (K) of 24, 32, 40, or 48 bits.
STATUS		
BIT SYNC LOCK indicator		When lit, indicates that the bit synchronizer is in lock.
FRAME SYNC LOCK indicator		When lit, indicates that the frame synchronizer is in lock.
NIA indicator		When lit, indicates that the 642B computer or TDC has not acknowledged Input Data Requests (IDR) or External Interrupts (EI).
QUICK LOOK indicator		When lit, indicates that the unit has failed to successfully decode one or more frames.
DECODED DATA indicator		When lit, indicates that the unit is decoding data successfully.
LAMP TEST momentary pushbutton		Lights all indicators; data indicators display 88.
TAIL PATTERN thumbwheels		Allows selection of the encoded frame sync pattern and flush bits.

▼Specified in NOSP.

introduced by the 330 bit sync for frames from 256 to 1024 bits in length. For frames from 1025 to 2048 bits in length, the input memory delays by 2 frames; therefore, the system delay is 3 frames plus the delay introduced by the 330 bit sync.

(c) Quick-look Capability. If the received encoded data is extremely noisy, the extra decisions required may cause the frame being decoded to be overwritten by an incoming frame. To prevent this, a quick-look frame is stored in the output memory while the frame is being decoded. (A quick-look frame is data that is decoded by performing a fixed mathematical function on the received data.) No error correction is performed on quick-look data. When it is determined that a frame of data will be overwritten (i.e., the decoder has run out of time), the output multiplexer is preset to output quick-look data during that frame time. The decoder provides a one-bit flag with the parallel output data to indicate that the frame is a quick-look frame. The DDPS system includes this flag in the DDPS block to indicate to the data user that the reliability of the data is reduced.

(2) Bypass. In bypass mode, the decoder portion of the system is bypassed for the parallel data output. The output data multiplexer selects the parallel data output from the 403 frame sync and transfers this directly to the TDC or 642B EMU. In this mode the system supplies no more than one bit of delay plus the delay through the 330 bit sync. The serial output still comes from the decoder in this mode and will always be decoded data. If, however, uncoded data is being processed, the serial output will be invalid.

c. 403 Frame Sync Capabilities

(1) EOF Pulses. The 403 frame sync supplies EOF pulses and a complement data flag. The decoder uses the EOF pulses to identify the frame for proper storage in memory. When the complement data flag is true, the sequential decoder inverts the data to restore it to its true condition.

(2) Status Flags. The 403 frame sync provides four status flags: bit slip, frame dropout, frame sync error, and frame sync validity. These flags are generated by the frame sync which decommutates encoded data. The decoder buffers the flags for 0, 3, or 5 frames depending on the mode and frame length, and outputs them with their associated frames. Due to the ability of the decoder to correct data dropouts, the flags may indicate that the frame contains bits in error but the decoder output may be a perfect image of the original data stream.

(3) Transfers. The frame sync also provides parallel data transfers for use in the bypass mode. When the system is used in decode mode, the 403 frame sync should not be programmed for a window.

d. 636 Transistor-transistor Logic/642B Level Shifter. For applications in which the sequential decoder transfers the parallel output to a 642B EMU, the system is provided with a model 636 Transistor-transistor Logic (TTL)/642B level shifter. The model 636 TTL/642B level shifter is a general purpose device which translates TTL signal levels to negative levels for data transfers to a 642B computer.

4.7.2 MODEL 100 SEQUENTIAL ENCODER

The Model 100 sequential encoder convolutionally encodes a data stream (typically from a PCM simulator) for use in system level verification of the sequential decoder system. Included in the unit is a quick-look decoder for the encoded data generated. Outputs of the decoder and encoder are compared and when an error occurs, the DATA ERROR indicator lights. Table 4-63 lists the equipment characteristics and table 4-64, the front-panel controls and indicators.

Table 4-63. Sequential Encoder Characteristics

Parameter	Characteristic
Input Power Requirements	100 to 125 Vac, 47 to 440 Hz, 45 W maximum power dissipation
Logic Levels	
Input	TTL or negative (-6 V, logic 0; 0 V, logic 1)
Internal	Complementary Symmetry Metal Oxide Semiconductor (CMOS), 12 V
Output	Bilateral, ±0.25 V to ±2.5 front panel adjustable
Logic Format (Code Type)	
Input	NRZ-L
Internal	Positive logic
Output	NRZ-L or BiØ-L
Bit Rate/Clock Rate	
Input	1 Hz to 50 kHz
Output	2 Hz to 100 kHz
Impedance	
Input	51 ohms or 1 Kohm
Output	50 ohms
Logic Power Requirement	Voltage, +12 Vdc at 560 mA and -12 Vdc at 540 mA

Table 4-64. Sequential Encoder Front-panel Controls and Indicators

Control/Indicator	Position	Purpose
DATA INPUT		
CLOCK ERROR indicator		Lit when the input clock is missing for more than 2 seconds.
50/1 Kohm	50 ohm	Selects 50-ohm input impedance.
	1 Kohm	Selects 1-Kohm input impedance.
TTL/NEG	TTL	Selects TTL input logic levels.
	NEG	Selects negative input logic levels.
ENCODER		
DATA ERROR indicator		Lit when the decoded data does not equal the input data.
▼LENGTH	24 32 40 48	Sets the encoding constraint length to 24, 32, 40, or 48 bits.
OUTPUT		
Level potentiometer		Controls output level.
NRZ/BiØ	NRZ	Selects NRZ-L output code.
	BiØ	Selects BiØ output code.
POWER		
Indicator		When lit, indicates that ac power is applied to the unit.
Switch	ON	Applies ac power to the unit.
	OFF	Removes ac power from the unit.

▼Specified in NOSP.

4.8 MONITOR MODEL 758 CHANNEL SELECTOR

The channel selector provides the capability of separating parallel words from a PCM or PAM/PDM decommutator into desired data points. The selected digital data is fed to 24 Digital-to-analog Converter (DAC) stages and to 10 optional groups of 10 discrete or bilevel stores, providing for 100 bilevel events. The resulting analog current of a DAC stage is converted to an equivalent voltage by operational amplifiers, and the voltage is presented to a rear connector. Any of the 24 analog DAC channels may be selected for monitoring on a front panel by means of thumbwheel switches. Figure 4-33 is a block diagram of the 758 channel selector. Refer to table 4-65 for equipment characteristics, and to table 4-66 for front-panel control functions. Figure 4-34 is a layout of the programmable patchboard.

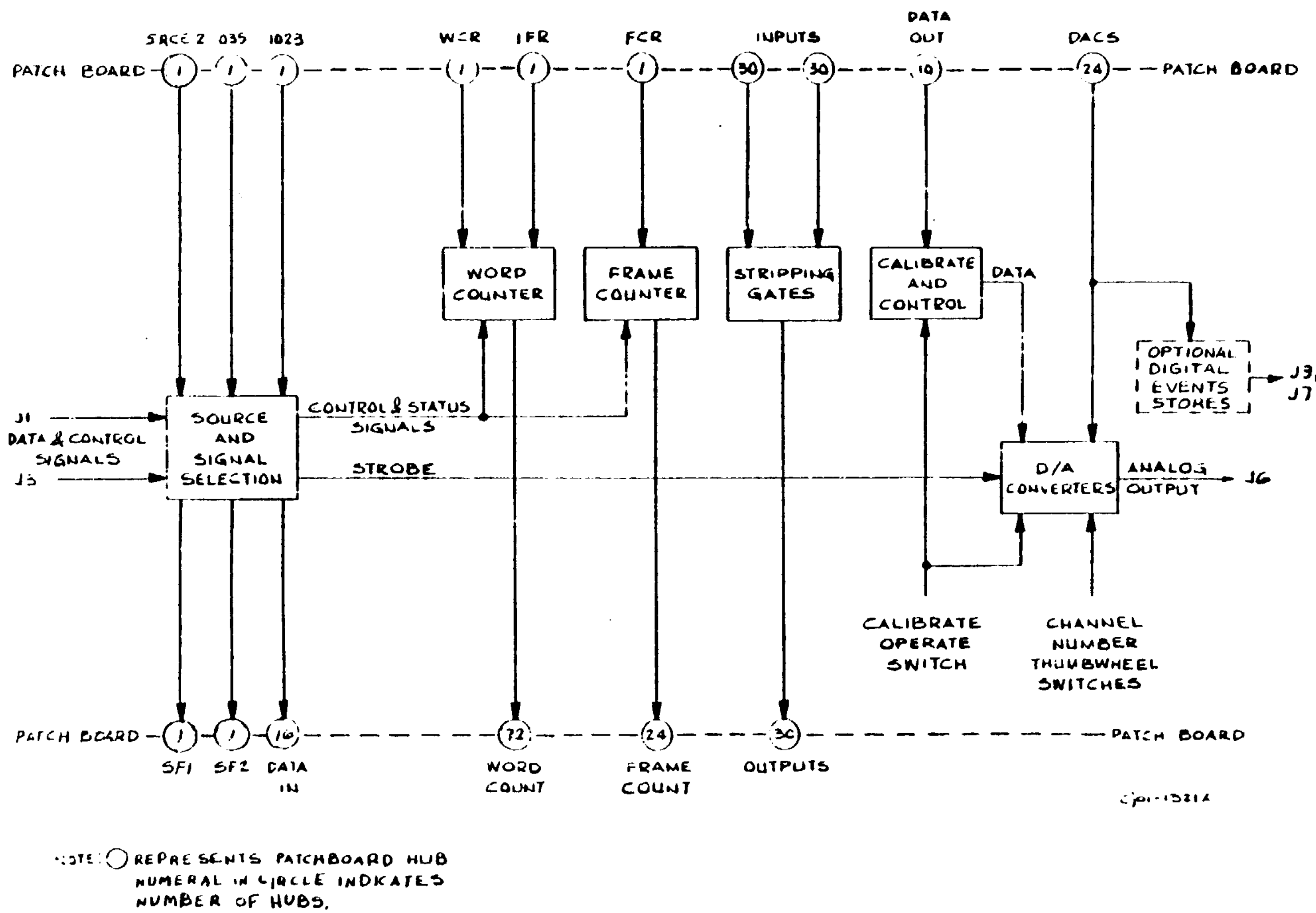


Figure 4-33. Model 758 Channel Selector Block Diagram

Table 4-65. Model 758 Channel Selector Characteristics

Parameter	Characteristics
INPUT	
Data	Up to 16 bits.
Rate	Up to 300,000 words per second.
Signal Levels	Negative = 0.0 to 0.5 V. Positive = +4.5 V (Plus or Minus) 1.0 V.
Control Signals	Word rate clock Frame rate clock. Subframe 1 rate clock. Subframe 2 rate clock. Synchronizer status.
ANALOG OUTPUT	
Number of Channels	Six in groups of three (DAC's 10 through 15 modified).
Output Level	0.0 to +10.0 V, full scale.
Resolution	8 bits (modified).
Output Current	Up to 5 MA, short circuit protected and current limited.
Digital Output	Ten 10-bit groups.
Relay Output	Six logic level closure (modified).

Table 4-66. Model 758 Channel Selector Front-panel Controls and Nominal Settings

Control	Position	Purpose
POWER	<u>ON</u>/OFF	Applies ac power to unit.
CALIBRATION	<u>OPERATE</u>/0%/25%/50%/75%/100%	Rotary switch for selecting mode of operation. When set to OPERATE, incoming data is processed, the other positions place the unit in the calibrate mode, and permit selection of five points of calibration.

Table 4-66. Model 758 Channel Selector Front-Panel Controls and Nominal Settings (cont)

Control	Position	Purpose
CONVERT pushbutton	Momentary	When activated, loads the calibration value selected by the CALIBRATION switch into the DAC channel selected by the channel number thumbwheels.
CHANNEL	00 to 99	Permits selection of any of the 24 DAC channel positions for display on front-panel meter.
PATCHBOARD	▼252 hubs	Permits selection and control of data through the channel selector.
▼ Specified in NOSP.		

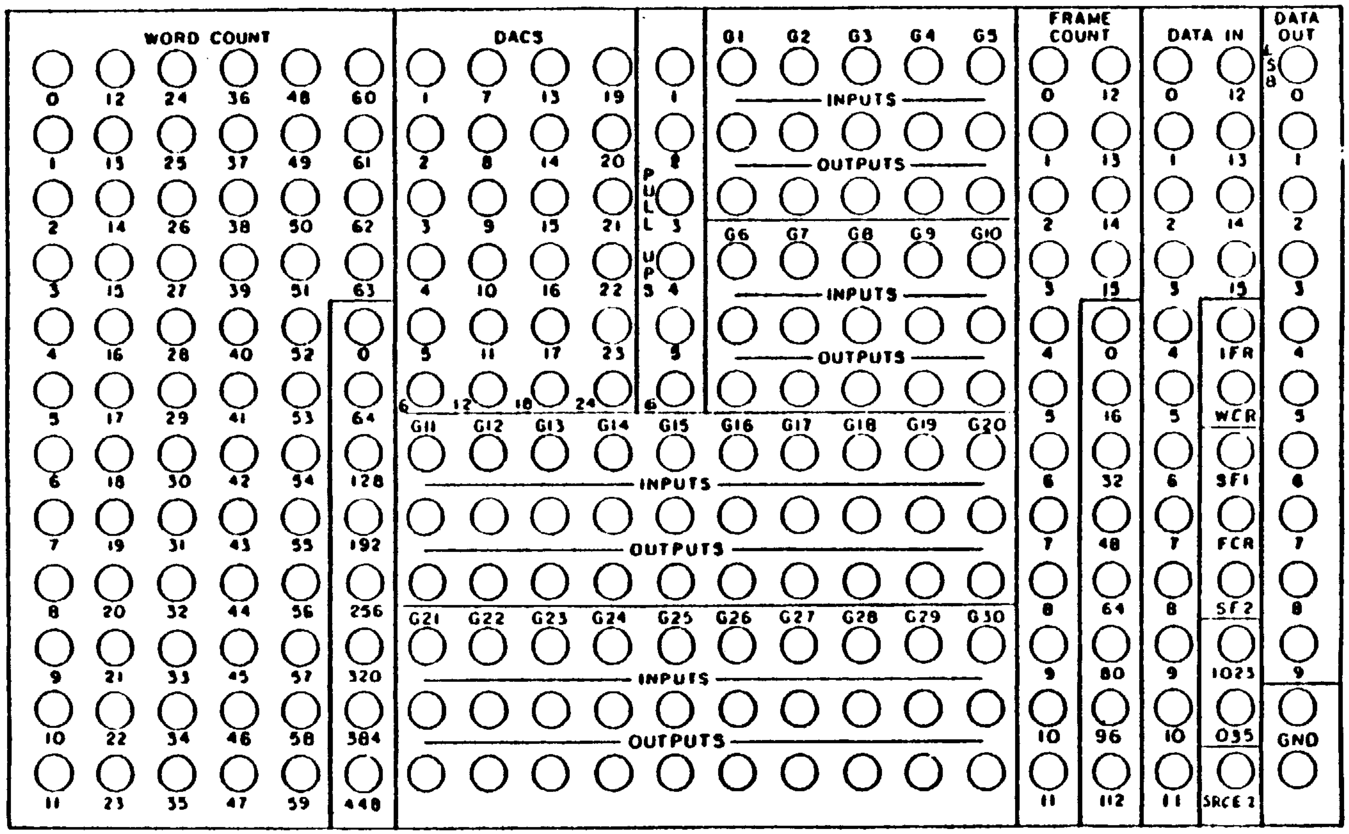


Figure 4-34. Model 758 Channel Selector Programmable Patchboard

SECTION 5. MISSION-UNIQUE EQUIPMENT

SECTION 5. MISSION-UNIQUE EQUIPMENT

5.1 GENERAL

5.1.1 Mission-unique equipment contained in this section does not apply to all stations within the STDN. This equipment, when required for support purposes, will be identified in the applicable NOSP.

5.1.2 Underscored entries appearing in the Position column in tabular information for controls and indicators indicate nominal settings.

5.2 SPECIAL EQUIPMENT

Special equipment for specific missions is as follow:

Mission	Equipment
a. SMS/GOES	Model 603 Simulator and Model 610 RTDU.
b. OAO	Model CT-1 Converter.
c. Nimbus	High Data Rate Storage System (HDRSS) Demultiplexer.
d. Landsat	Data Collection System (DCS), Subcarrier Demodulator, Multispectral Scanner (MSS), and MSS/RSE Test Set.

5.2.1 SMS MODEL 603 SIMULATOR

The SMS Model 603 Simulator generates electronic signals in IRIG channels 12 and B which simulate demodulated signals from the telemetry system of the Synchronous Meteorological Satellite (SMS). The output of the simulator is used to test the Real-time Data Unit (RTDU) Model 610. Figure 5-1 is the block diagram of the Model 603 Simulator, table 5-1 lists the characteristics, and table 5-2 lists front-panel control functions.

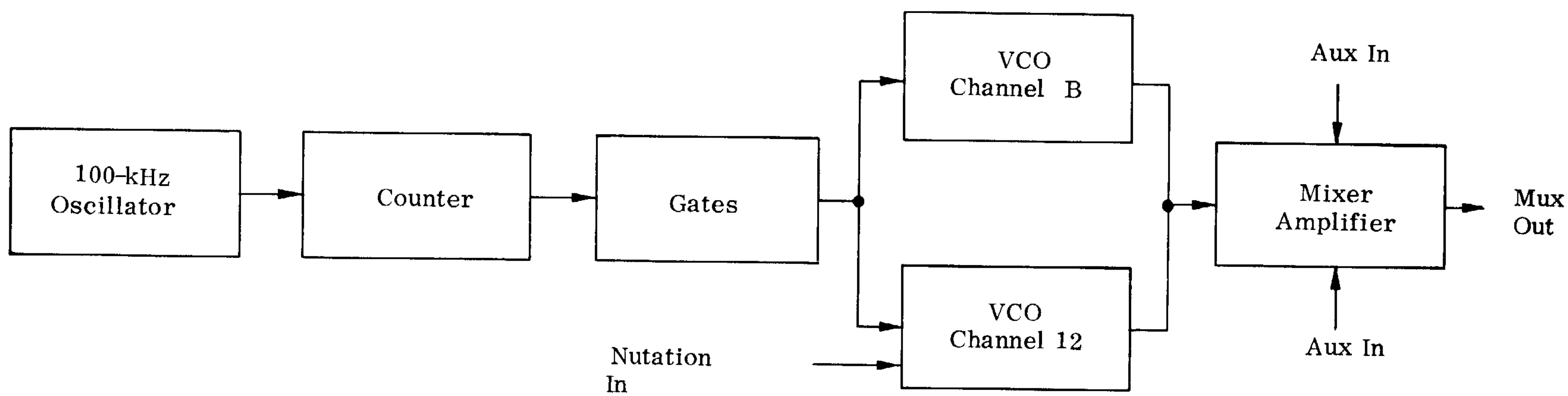


Figure 5-1. SMS Model 603 Simulator Block Diagram

Table 5-1. SMS Model 603 Simulator Characteristics

Parameter	Characteristics
Sun Simulation	Generates a Leading Edge of Sun (LES) pulse 2.00 msec wide, and a Trailing Edge of Sun (TES) pulse 2.00 msec wide, spaced 12.15 msec apart, which occur as output tones at 3.15 kHz.
Earth Simulation	Generates an earth signal 333.43 or 666.23 msec wide (selected by POSITION switch), starting 6.39, 187.51, or 749.43 msec after the LES. The earth signal occurs at 26.5 kHz.
Event Simulation	Generates a signal which reoccurs in every spin period, at an adjustable 300- to 600-msec interval after LES and continues for an adjustable 50 to 100 msec. Switches allow selection of the specific event; Execute-Verify (E-V), Apogee Boost Motor (ABM), or Auxiliary Propulsion System (APS). The E-V event occurs at 10.5 kHz, and the APS event occurs at 10.0 kHz.
Idle Simulation	Generates a 34.0-kHz signal whenever neither sun, earth, nor E-V is present.
Nutation Simulation	Takes an externally generated 1.5-Hz signal at 1 Vrms, offsets the signal as appropriate, and presents the signal centered around 11.0 kHz.
Priorities	The relative priorities of signals are established automatically within the simulator. The sun takes priority over earth, which takes priority over E-V, which takes priority over Idle. The ABM takes priority over APS, which takes priority over Nutation.

Table 5-1. SMS Model 603 Simulator Characteristics (cont)

Parameter	Characteristics
Noise Simulation	Generates white noise with a bandwidth from less than 5 kHz to greater than 50 kHz, and adjustable mixing level so that carrier-to-noise can be set at 6- to 30-dB.
Accuracy of Simulation	All intervals of sun and earth relationship are accurate to within 10 μsec. Tone output stability is 1 part in 10,000 for 1 hour after 30 minutes warmup.
Output Level	50 mA peak current, 50 Ω output impedance.

Table 5-2. SMS Model 603 Simulator Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies operating power to the unit.
NUTATION CONTROL		Adjusts amplitude of the nutation input.
SUN-EARTH POSITION switch	A B C D E	Sets the position relationship of the earth pulse to the sun pulses.
EVENT switch	OFF APS ABM E-V	Applies event signal to E-V, ABM, and APS channel or turns signal off.
EVENT-START control		Sets the point at which the event pulse starts in relation to the leading edge of the sun pulse.
EVENT-STOP control		Sets the point at which the event pulse stops in relation to the leading edge of the sun pulse.
OPERATE/CALIBRATE switches	SUN EARTH E-V ABM APS NUT IDLE	In the OPERATE position, the unit generates the simulated signals. In the CALIBRATE position, allows the selected channel to be biased.
CALIBRATE controls	SUN EARTH E-V ABM APS NUT IDLE	Used to adjust bias on the channel selected to CALIBRATE.
CHANNEL 12 switch	ON OFF	Connects input to channel 12 VCO.
CHANNEL B switch	ON OFF	Connects input to channel B VCO.
NOISE switch	ON OFF	Applies power to the noise generator.
NOISE control		Adjusts the amplitude of the noise in the multiplexer.

Table 5-2. SMS Model 603 Simulator Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
TES DISABLE switch	Momentary	Disables the TES pulse from the simulator.
Multiplexer Model 404		
LEVEL control		Sets gain of output summing amplifier for noise input only.
VCO Model 406		
OFF/+/- switch	OFF + -	In the OFF position, disconnects output. In the + or - position,sets deviation polarity.
INPUT LEVEL control		Adjusts input signal attenuation, thus the deviation sensitivity.
FREQUENCY control		Adjusts the center frequency.
OUT control		Adjusts output amplitude.
POWER indicator		Indicates when power is applied to the unit.

5.2.2 MODEL 610 REAL-TIME DATA UNIT

The RTDU translates analog attitude information from the Synchronous Meteorological Satellite (SMS) into a format that can be used by the Multiple Satellite Operation Control Center (MSOCC). The attitude data supplied consists of demodulated Apogee Boost Motor (ABM), Auxiliary Propulsion System (APS), Execute-verify (E-V), and Nutation signals, plus demodulated sun and earth sensor signals. It also includes measurements of sun and earth intervals, time between leading edge of sun and leading edge of earth, and spacecraft spin period. The RTDU converts the analog data into a format suitable for transmission over the NASCOM voice/data circuits. The RTDU consists of two major units: the attitude data and nutation control unit and the FM multiplexer unit. Figure 5-2 is a block diagram of the RTDU, table 5-3 lists the characteristics, and table 5-4 lists front-panel control functions.

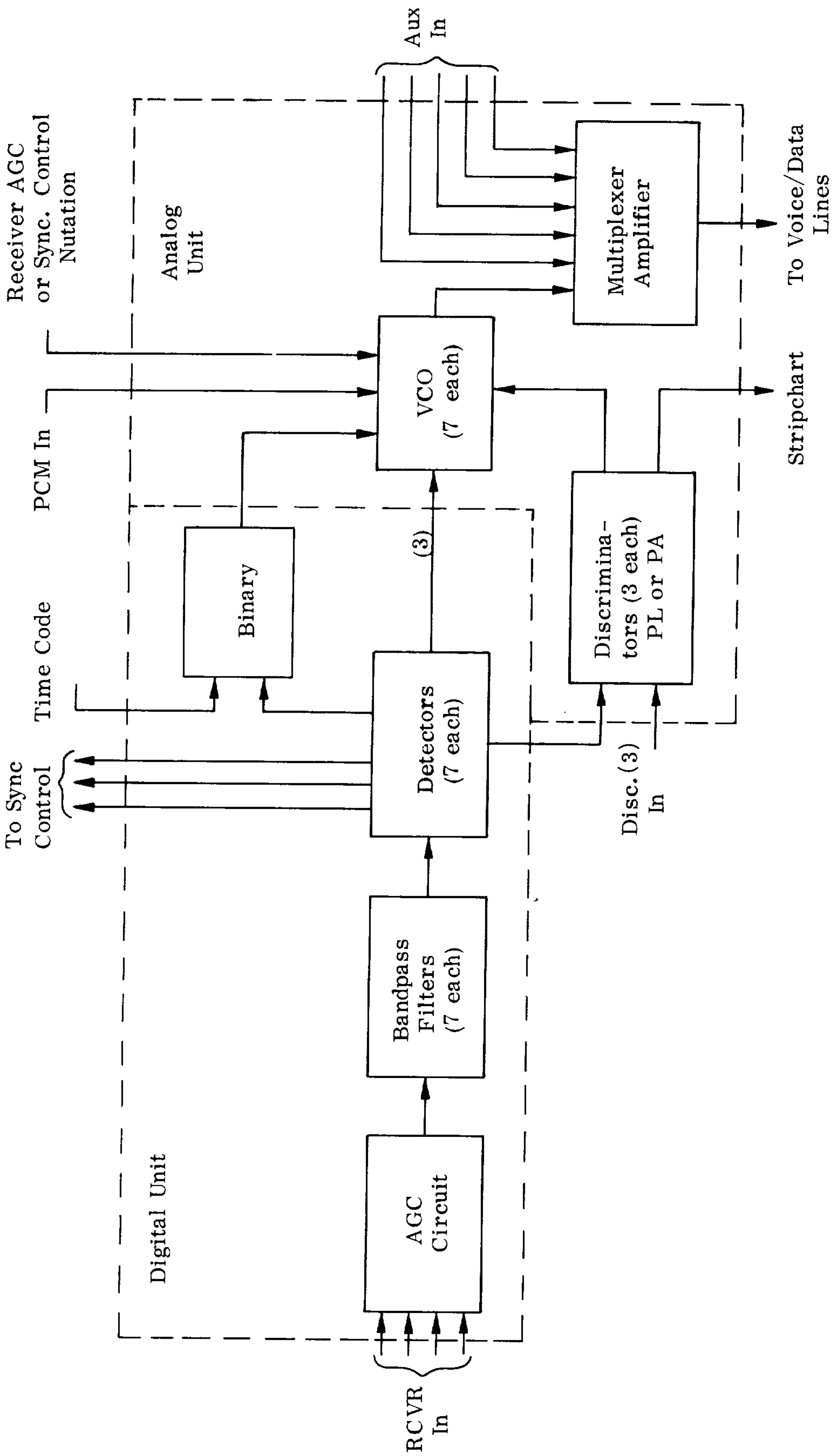


Figure 5-2. Model 610 Real-time Data Unit Block Diagram

Table 5-3. Model 610 Real-time Data Unit Characteristics

Parameter	Characteristic
Signal Inputs	
Frequency Multiplex	Two subcarriers, standard IRIG Channels 12 and B.
Serial PCM	187.99 b/sec.
Clock Pulse	1-MHz rate.
Time Code	24 bits, parallel BCD, updated 10 times per second.
Input Signal Levels	0.1 to 10.0 Vpp, 5 to 10 Vpp, 0.25 to 5 Vpp. Positive 4.5 ±1.5 V and 0 0.5 V, or negative 6.0 ±1.5 V and 0 0.5 V selectable by internal switch.
Input Impedance	50 ohms, 90 ohms, 100 k ohms, selectable from front panel, 100 k ohms, 50 ohms, no greater than 50 pF, 1000 ohms.
Signal Outputs	
Frequency Multiplex	Seven subcarriers, IRIG standard channels 1, 2, 3, 4, 5, 6, and 7.
Sun sensor pulse	Synchronous controller.
Earth sensor pulse	Synchronous controller.
Execute-verify pulse	Synchronous controller.
Nutation pulse	Synchronous controller.
Nutation signal	Stripchart recorder.
Output Signal Levels	
1 to 10 V (open circuit)	Nominally 5 V across 50 ohms, single-ended and 600 ohms balanced.
4 to 5 Vpp	Across 50 or 90 ohms.
4 to 5 Vpp	Across 50 or 90 ohms.
4 to 5 Vpp	Across 50 or 90 ohms.
10 Vpp	Across 50 ohm load.
10 Vpp	Across 50 ohm load.

Table 5-3. Model 610 Real-time Data Unit Characteristics (cont)

Parameter	Characteristic
Output Signal Formats	
Output No. 1	
Channel 1 (0.40 kHz, ±7.5%)	Nutation signal from SMS.
Channel 2 (0.56 kHz, ±7.5%)	ABM pulse from SMS.
Channel 3 (0.73 kHz, ±7.5%)	Patched on rear panel of data unit. Normally nutation signal, but can be used to send receiver AGC information.
Channel 4 (0.96 kHz, ±7.5%)	E-V pulse from SMS.
Channel 5 (1.30 kHz, ±7.5%)	APS pulse from SMS.
Channel 6 (1.70 kHz, ±7.5%)	Reconstructed serial PCM from SMS at 187.99 b/sec.
Channel 7 (2.30 kHz, ±7.5%)	Attitude data formatted in digital section of RTDU; serial digital data at 299.94 b/sec. Words are transmitted with Most Significant Bit (MSB) first. Word content is as follows: Word 1: 32 bits, synchronization code. Word 2: 24 bits 23-22 bits (tens of hours, BCD). 21-18 bits (units of hours, BCD). 17-15 bits (tens of minutes, BCD). 14-11 bits (units of minutes, BCD). 10-8 bits (tens of seconds, BCD). 7-4 bits (units of seconds, BCD). 3-0 bits (tenths of seconds, BCD). Word 3: 24 bits (first 11 bits are 0 fillers; last 13 bits are binary representation of the sun interval; last bit is 10 μsec resolution). Word 4: 24 bits (first eight bits are 0 fillers; last 16 bits are binary representation of the time from the LES to the last LEE pulse or pseudo LEE pulse in the spin period; last bit is 10 μsec resolution). Word 6: 24 bits [first 7 bits are 0 fillers; last 17 bits are binary representation of the Spin Period (SP); last bit is 10 μsec resolution].

Table 5-4. Model 610 Real-time Data Unit Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
DIGITAL display	Bits 0 to 23	Displays one of five digital words selected by the DISPLAY SELECT switch.
DISPLAY SELECT switch	BCD TIME SUN LES/LEE EARTH SPIN PERIOD	Selects digital word to be displayed on the DIGITAL displays.
THRESHOLD meters	SUN EARTH IDLE EXEC/VER APS ABM	Indicates setting of the particular threshold detector circuit potentiometer. Not calibrated in any particular unit.
POWER switch/indicator	ON OFF	Applies and indicates when power is applied to the unit.
▼ SOURCE switch	A B C D	Selects input signal source.
▼ IMPEDANCE switch	50 90 100	Selects input impedance.
LOCK indicator		Extinguishes when overflow (2^{12}) bit occurs in the SI counter, and remains out for approximately 0.1 sec.
ACTIVE/INACTIVE switch	ACTIVE INACTIVE	Enables or inhibits the RTDU data stream output.
▼ MODE switch	NRZ-L NRZ-M NRZ-S BIØ-L EARTH PULSE	Selects one of four serial data words. The EARTH PULSE position bypasses the digital portion of the data unit to VCO No. 7 input.
<u>FM Multiplexer Unit</u>		
VCO's 1 through 7 POLARITY switch	OFF - +	Selects polarity deviation. In the OFF position, disconnects VCO output.

▼ Specified in NOSP.

Table 5-4. Model 610 Real-time Data Unit Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
FM Multiplexer Unit (cont)		
IN LEVEL control		Sets input signal level to the VCO and thus the deviation sensitivity.
FREQ control		Adjusts the center frequency of the VCO.
OUT control		Adjusts output level of the VCO.
Mixer Amplifier		
LEVEL control		Sets level of multiplexed input signal to the module.
Model 432P Discriminator		
ZERO control		Adjusts input signal to discriminator in the middle of the passband.
LOSS LOCK indicator		Lights red when loss of phase lock occurs in the discriminator.
LOW SIG indicator		Lights red when input signal amplitude falls below zero clamp level.
DEVIATION meter		Indicates amount of signal deviation from center frequency.
GAIN control		Used to adjust discriminator signal output at bandedge.
Model 430P Discriminator		
SIGNAL LEVEL meter		Indicates relative amplitude of Nutation input signal applied to 432P Discriminator. Calibrated Vrms.
MODE switch	PL PA	Selects either phase lock or pulse averaging discriminator output signals.
INPUT switch	1 2 3	Selects discriminator 1, 2, or 3 input signal and applies it to the 430P meter circuit.

Table 5-4. Model 610 Real-time Data Unit Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
Model 430P Discriminator (cont)		
RANGE switch	.05 .15 .50 1.5 5.0	Selects meter scale in Vrms.
Model 402 Discriminator		
DEVIATION meter		Indicates frequency deviation of input signal applied to the discriminator.
GAIN control		Adjusts level of output signal at bandedge.
ZERO control		Adjusts discriminator output to zero at center frequency.
Test Monitor Switches		
Switch 1	Demod Out 1 2 3 Demod In 1 2 3 SUN EARTH E-V ABM APS	Selects various signals throughout the RTDU and applies them to the front-panel test jack.
Switch 2	MIXER GND VCO 1 2 3 4 5 6 7 IDLE	Same as switch 1.

5.2.3 OAO FSK-TO-PSK CONVERTER, MODEL CT-1

5.2.3.1 The converter, shown in figure 5-3, decodes the external PCM command signals and reconstructs a serial data stream for external recording. FSK-to-PSK and split-phase techniques are used in the conversion process. The command signal consists of serial FSK data frequencies summed with the data clock frequency. The summed mode input is amplified and filtered to remove the amplitude variations, leaving only FSK data frequencies. Filters separate the detected signal into component high and low frequencies, which correspond to binary 0 and 1, respectively. The 0 and 1 signals are then integrated over the major portion of each data bit transmission period. Squaring circuits produce fast rise- and fall-time signals from the integrated waveforms, generating representative samples of the original 0 and 1 data bits. A bit activity detector, controlled by a clock-generated trigger, determines which sampled bit is active at each clock period. The bits are gated out serially to reconstruct the data stream. Synchronization of the reconstructed data with the input data is produced by a phase- and frequency-corrected VCO clock, which clocks the data through phase selector and output circuits to produce a split-phase serial data stream. Either polarity of the output signal can be selected to compensate for signal inversions that can occur in the external circuits between transmission and recording. There are no front-panel controls on this chassis.

5.2.3.2 The VCO clock signal is continuously retimed to the input data to maintain synchronization. As the command signal is processed to recover the data bits, the amplified summed mode signal is also processed to recover the data clock signal. A clock detector removes the data clock from the summed mode signal and filters out the bit frequencies. The clock detector operates in conjunction with phase detector and selector circuits to determine whether the data clock phase should be corrected with respect to the data bits. Phase corrections are incorporated and then the phase-corrected data clock is forwarded to a phase comparator differential detector. A VCO clock signal is applied to the phase comparator differential detector at the same time, where it is compared with the phase and frequency of the data clock. A difference signal is generated indicating the relative phase between the two signals. Based on the amount and direction of phase difference, an Add or Delete signal is generated. The Add or Delete signal is sent to an Add/Delete gate in a VCO clock counter circuit to control the VCO count. This signal effectively causes the VCO clock counter to add or delete pulses to advance or retard the phase of the VCO clock. If the phase comparison indicates that a frequency correction is necessary, a count-up or count-down signal is generated and is sent to an up/downcounter and D-A converter. A VCO clock signal is applied to the up/downcounter at the same time, causing the counter to count up or down in response to the control signal. The counter digital output is converted to analog by the D-A converter, which is then used to control the frequency of a VCO. The VCO responds by adjusting the frequency upward or downward. The VCO resting frequency is approximately 1 MHz; the variations cover a range of approximately ±30 kHz. A frequency divider counts down the VCO pulse frequency. The total countdown time depends on the amount of frequency and phase correction required, as determined by Phase Advance and Retard gates in conjunction with the Add/Delete gate and the Add/Delete signals. The phase is advanced or retarded by adding or deleting pulses in the VCO clock counter as mentioned previously, and then another comparison is made. The phase comparison, phase correction, and frequency correction process is repeated continuously until the phase difference is reduced to zero and the VCO clock is brought into phase and frequency with the data clock. Clock output and control circuits route clock and gate signals to the converter circuits to time various internal functions. The time required by the converter to establish synchronization of the reconstructed data is minimized by the transmission of a series of 0 bits at the beginning of the command signal. This has the effect of presetting the up/downcounter to a particular count and the VCO to a given frequency before data transmission begins.

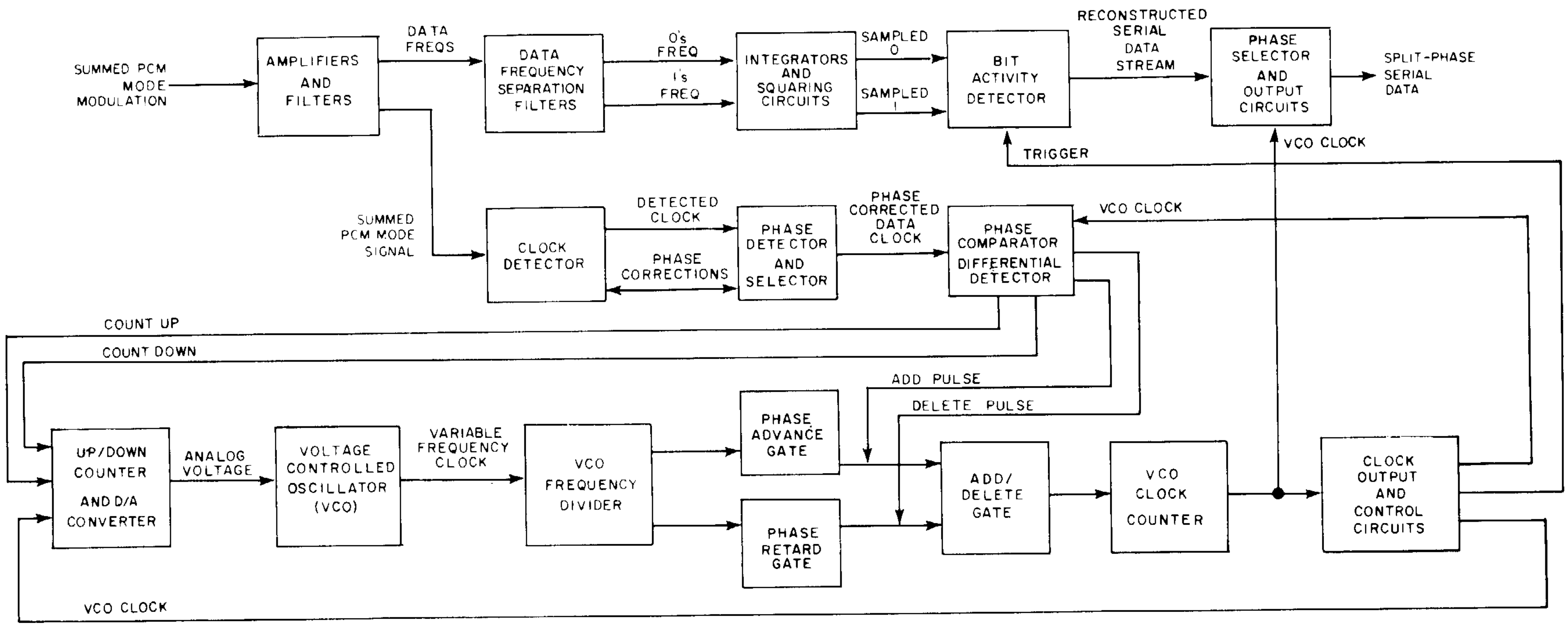


Figure 5-3. OAO FSK-to-PSK Converter, Model CT-1, Simplified Block Diagram

5.2.4 NIMBUS

5.2.4.1 The Nimbus High Data Rate Storage System (HDRSS) demultiplexing equipment is a five-channel unit designed to accept the composite output signal from a telemetry receiver and extract the downlink information from this input signal. The demultiplexer is currently in use for support of the Nimbus 6 mission only. The unit processes the following downlinked information:

a. Channel 1 (12 Hz to 168 kHz). Versatile Information Processor (VIP) data at 128 kb/sec.

b. Channel 2 (175 to 343 kHz). High-resolution Infrared Radiometer Spectrometer (HIRS) data at 108.5 kb/sec.

c. Channel 3 (400 to 530 kHz). Temperature, Humidity Infrared Radiometer (THIR) 6.7 micron wavelength video.

d. Channel 4 (565 to 695 kHz). THIR 11.5 micron wavelength video.

e. Channel 5 (722 to 890 kHz). Limb Radiance Interferometer Radiometer (LRIR) video.

5.2.4.2 The input signal to the demultiplexer is a composite 1.2- to 890-kHz subcarrier at 1 Vpp. The subcarrier is separated into five discrete signals by bandpass filters prior to application to the individual channels within the unit.

5.2.4.3 Output levels from the demultiplexer are at a nominal 2.0 Vpp for PCM data (VIP and HIRS) and 1.0 Vpp for the video (THIR and LRIR) signals.

5.2.4.4 The outputs from the demultiplexer are provided to recording and monitoring equipment on the station or transmitted to GSFC when required for special support or testing. See figure 5-4 for a block diagram of the demultiplexer.

5.2.4.5 There are no front-panel controls or indicators on the unit. It is supplied with ±24 V from an external power supply.

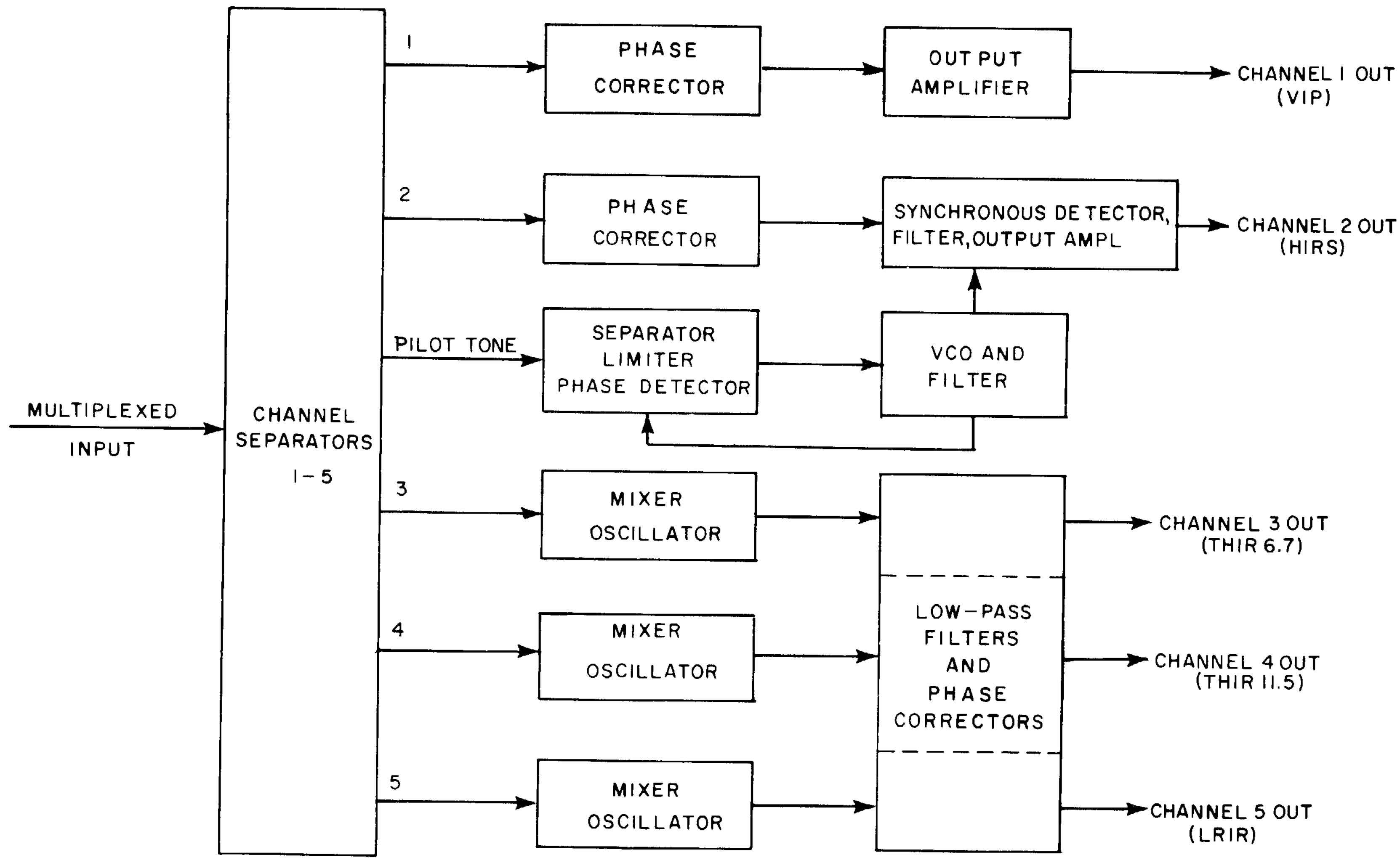


Figure 5-4. Nimbus Demultiplexer, Block Diagram

5.2.5 LANDSAT DATA COLLECTION SYSTEM

5.2.5.1 The Landsat Data Collection System (DCS) is a system designed to collect data from locations throughout the continental U.S. and relay that data to GSFC for processing and distribution to the data users. The Landsat DCS consists of up to 1000 Data Collection Platforms (DCP's), the DCS subsystem in the satellite, the DCS Receiving Site Equipment (RSE), and the data processing equipment at GSFC. See figure 5-5 for a block diagram of the DCS system.

5.2.5.2 Each DCP can monitor up to eight sensors, digitizing and multiplexing this data, coding it with a convolutional encoder, and uplinking it to Landsat.

5.2.5.3 The DCS subsystem in the Landsat translates the DCS uplink carrier (401.55 MHz) to the 1.024-MHz DCS subcarrier which is then modulated on the S-band downlink carrier.

5.2.5.4 The DCS RSE accepts the 1.024-MHz subcarrier from the USB receiving system, demodulates it, decodes and quality checks the data in a convolutional decoder, and formats this data into the 1200-bit NASCOM block for transmission to GSFC. See figure 5-6 for Landsat NASCOM block format. Provisions in the DCS/RSE allow magnetic tape recording of the data at various stages of processing for data playback or retention. See figure 5-7 for Landsat DCS/RSE simplified block diagram.

5.2.5.5 The Landsat DCS uplink and downlink characteristics are as follows:

a. Uplink frequency: 401.55 MHz.

b. Downlink DCS subcarrier frequency: 1.024 MHz.

c. Type modulation: FM/FSK.

d. Downlink FM deviation: ±3.5 kHz ±5 percent (FSK).

e. Symbol rate: 5 kb/sec.

f. Symbol format: Bi-phase, bi-level (Manchester II).

g. Symbols per burst: 190.

h. Burst duration: 38 msec.

i. Burst rate: Every 90 or 180 sec.

5.2.5.6 The 190-symbol 38-msec DCS data burst is made up as follows:

Symbol No.	Name	Use
1-30	Preamble	Bit synchronization
31-32	Sync (1)	Sync
33-54	ID	Identifies DCP
55-182	Data symbols	Data from 8 sensors
183-190	Encoder	Clears convolutional encoder

5.2.5.7 Refer to table 5-5 for the DCS front-panel control functions.

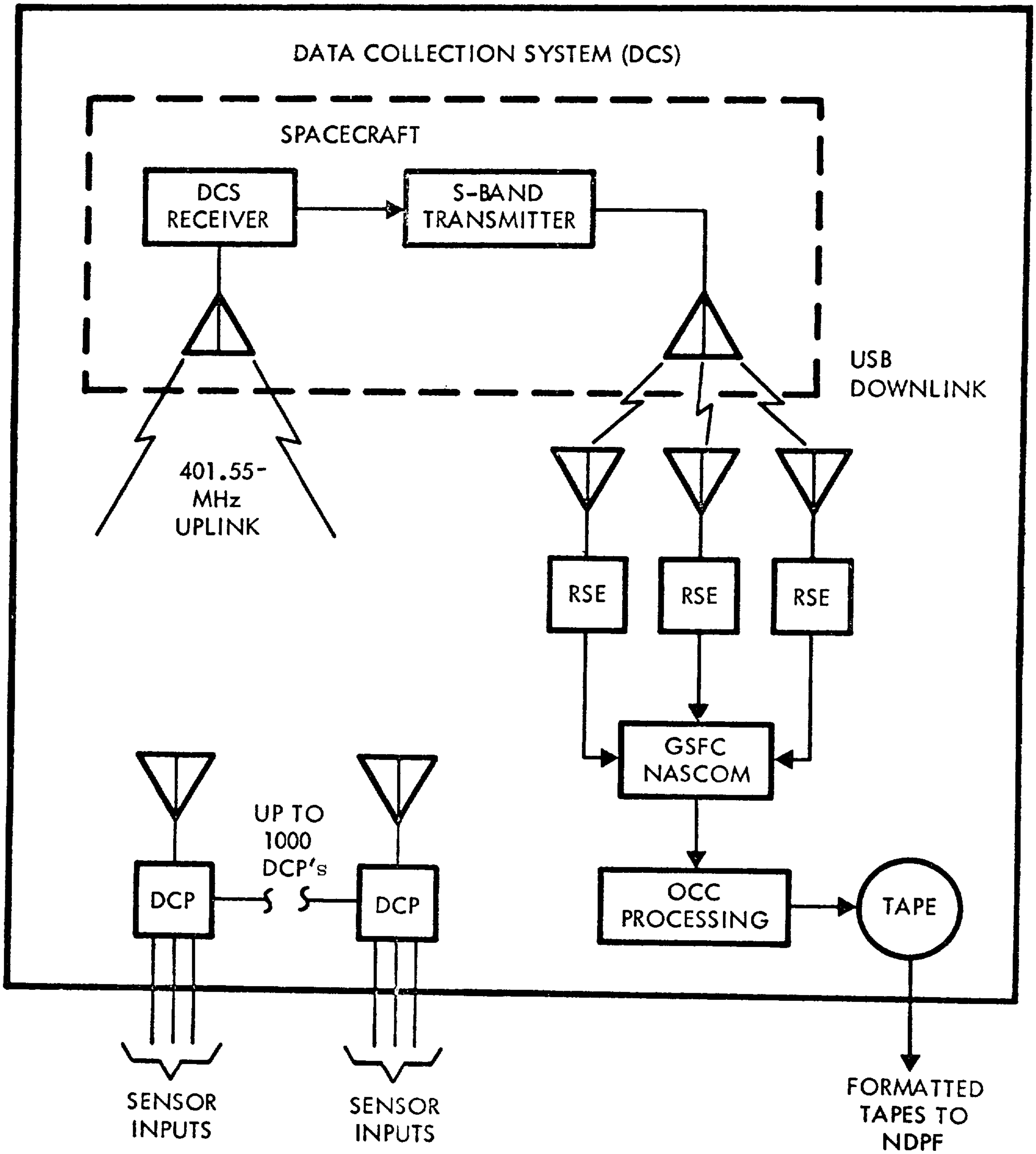


Figure 5-5. Landsat DCS Simplified Block Diagram

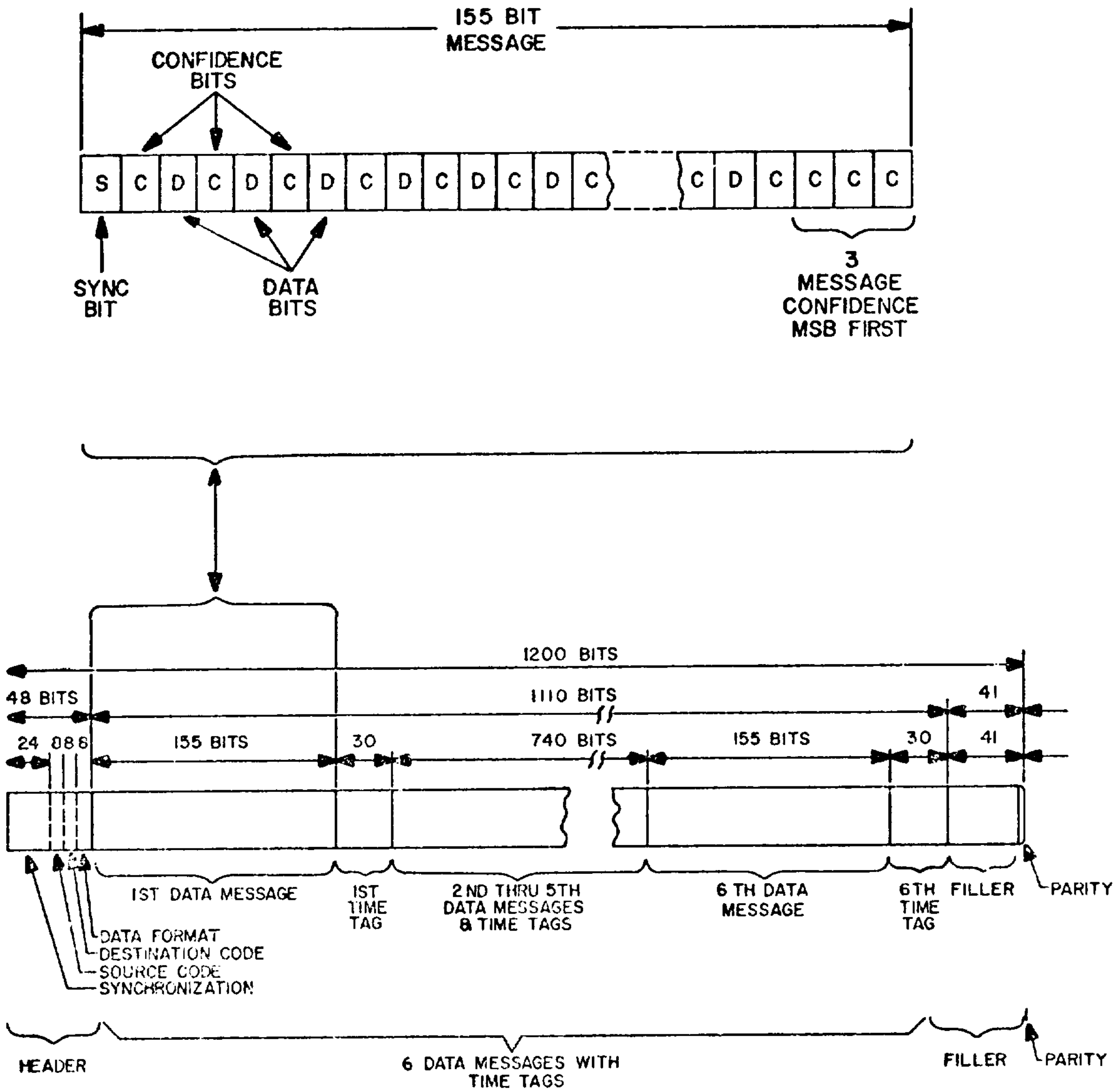


Figure 5-6. Landsat NASCOM Block Format

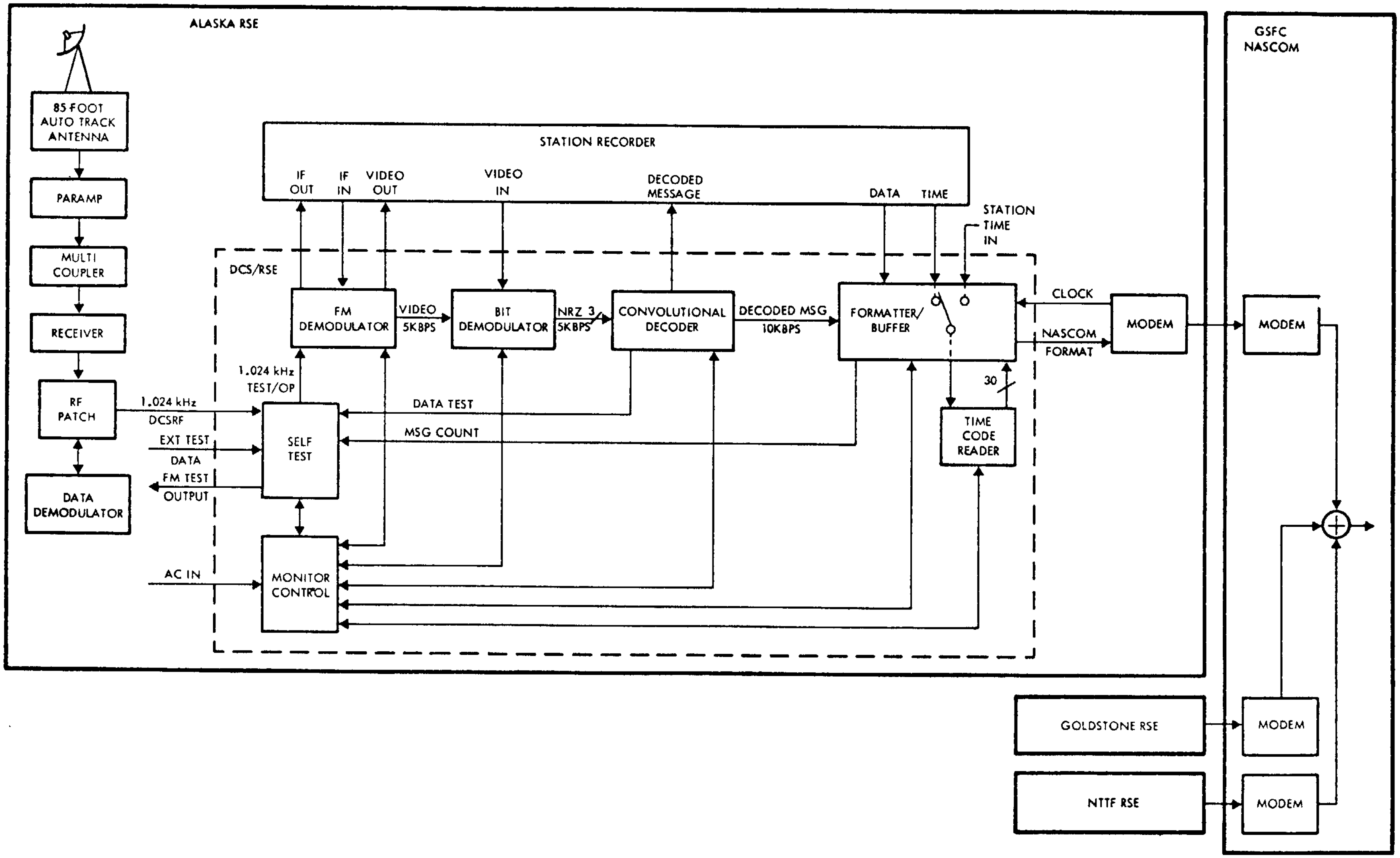


Figure 5-7. Landsat DCS RSE Simplified Block Diagram

Table 5-5. Landsat DCS Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position	Purpose
LAMP TEST PB	Momentary	Sets all voltage threshold circuits to light monitor indicators.
RESET PB	Momentary	Resets all voltage threshold circuits to extinguish indicators.
POWER circuit breaker	ON OFF	Applies ac power to DCS/RSE units.
RSE Time Code Reader		
READ CODE thumbwheel	IA-IRIG A code IB-IRIG B code IC-IRIG C (100-Hz carrier) CK-IRIG C (1-kHz carrier) IE-IRIG E (100-Hz carrier) EK-IRIG E (1-kHz carrier) N3-NASA 36-bit N2-NASA 28-bit BLANK (2)	Selects time code.
FWD/REV switch	FWD REV	Selects forward or backward time code reading.
POLARITY switch	+ -	Selects polarity of input time code signal.
POWER switch	ON OFF	Applies ac power to time code reader.
RSE FM Demodulator		
VCO CONTROL		
AUTO/MAN PBI	AUTO MAN	Selects manual front panel or AFC mode for the VCO.
Frequency knob	Variable	Sets VCO FREQ. when in manual mode. Used only in manual position.
CHANNEL STATUS		
INHIBIT (6 PBI's)	1 - 6 OFF	Manually inhibits selected channels.

Table 5-5. Landsat DCS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
RSE FM Demodulator (cont)		
PLAYBACK MODE PBI	PLAYBACK	In PLAYBACK mode, RF (1.024 MHz) input is disabled and 200-kHz IF input from recorder is enabled. On for P/B mode.
LAMP TEST PB	Momentary	Lights all CHANNEL STATUS indicators.
POWER PBI	ON OFF	Applies ac power to FMD.
RSE Bit Modulator		
INPUT SOURCE SELECT switch	RECEIVER RECORDER	Selects FM demodulator (RECEIVER) or tape recorder (RECORDER) as input source. RECORDER for P/B mode.
POWER PBI	ON OFF	Applies ac power to BD.
RSE Convolutional Decoder		
MODE PBI	TEST OPERATE	Selects operational mode or self-test mode.
TEST CONTROLS (Enabled in test mode)		
AUTO HALT/FREE RUN PBI	AUTO HALT	CD automatically stops processing when a message error is detected. Used only in test.
	FREE RUN	CD continues processing when error is detected.
RESTART PBI	RESTART	Restarts processing following AUTO HALT.
POWER PBI	ON OFF	Applies ac power to CD.
RSE Formatter/Buffer		
MASTER CLEAR PBI	CLEAR	Resets F/B to a starting point.
▼ SOURCE CODE switch	0-7	Sets station code in bits 25-32 of NASCOM header.
DESTINATION CODE switch	0-7	Sets destination code in bits 33-40 of NASCOM header. Set to 177_8
DATA FORMAT switch	0-7	Sets data format code in bits 41-48 of NASCOM header. Set to 156_8.
POWER PBI	ON	Applies ac power to F/B.

▼ Specified in NOSP.

Table 5-5. Landsat DCS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
RSE Formatter/Buffer (cont)		
DATA SOURCE switch	DECODER TAPE	Selects CD or tape recorder as input source. TAPE during P/B mode.
OVERFLOW RESET PB	Momentary	Resets F/B memory overflow detection circuit.
REQUEST TO SEND switch	2 position ON	Tells HSD modem that DCS/RSE is ready to send data.
RSE Self-test Unit		
D Display		
MESSAGE COUNTER PBI	Alternate action	Connects message counter to display readout.
GOOD MESSAGE PBI	Alternate action	Connects good message counter to display readout.
BAD MESSAGE PBI	Alternate action	Connects bad message counter to display readout.
MESSAGE ERROR PBI	Alternate action	Connects message error counter to display readout.
CLEAR PBI		Clears all four preceding counters.
Signal Quality		
C/KT ADJUST switch	-6 to +6 dB/Hz	Sets carrier-to-noise density of test signal.
NOISE ON/NOISE OFF PBI	NOISE ON NOISE OFF	Turns noise source on and off.
POWER PBI	ON OFF	Applies ac power to self-test unit.
VCO Control		
AUTO/MANUAL PBI	AUTO	VCO frequency is automatically shifted with each message sent.
	MANUAL	VCO frequency and modulation set manually.
MANUAL ADJUST switch	+ -	Sets VCO frequency when TEST MANUAL are selected.
VCO ON/VCO OFF PBI	VCO ON VCO OFF	Turns VCO on and off.

Table 5-5. Landsat DCS Front-panel Controls, Indicators, and Nominal Settings (cont)

Control/Indicator	Position	Purpose
RSE Self-test Unit (cont)		
Modulation Control		
FM FSK/CW PBI	FM FSK CW	Turns modulation on and off.
BURST/CONT. PBI	BURST	VCO is gated off between each message.
	CONT.	VCO is on continuously.
Test Mode Control		
TIME DELAY M SEC switch	.2 3 6 12 25	Selects spacing between test messages.
MESSAGE SELECT switch	PR PR 1 0 10 01	Selects internally-generated patterns for test message.
	EXT	Selects external signal for test message.
	EXT CTR	Routes external signal applied to EXTERNAL COUNTER jack to the message counter.
STU/RECEIVER PBI	STU RECEIVER	Selects the FMD input source in the test mode.
RUN/HOLD PBI	RUN HOLD	Starts or stops test messages in test mode.
MODE SELECT PBI	OPERATE TEST	Selects mode of operation of DCS RSE.

5.2.6 LANDSAT SUBCARRIER DEMODULATOR

5.2.6.1 The Landsat subcarrier demodulator receives frequency division multiplexed (FDM) signals from a telemetry receiver, separates the subcarrier, and processes the subcarriers. The received FDM signals consist of a 1024-kHz translated subcarrier (DCS), a 597-kHz (DUMP) subcarrier modulated with 1-kb/sec or 24-kb/sec PSK/PCM data, and a 768-kHz (real-time) subcarrier modulated with 1-kb/sec PSK/PCM data.

5.2.6.2 The 1024-kHz subcarrier is received and applied through a linear phase bandpass filter or direct to two amplifiers to provide two 1024-kHz isolated outputs.

5.2.6.3 The 597-kHz subcarrier is applied through one of two linear phase bandpass filters, depending on the modulation, to a pair of balanced mixers and mixed with a 597-kHz frequency from a voltage-controlled crystal oscillator (VCXO) which operates as a Costas phase-locked loop to detect the PSK/PCM data. The detected data is fed either direct or through a linear phase low-pass filter to two amplifiers to provide two PSK/PCM data outputs of either 1 or 24 kb/sec.

5.2.6.4 The 768-kHz subcarrier is applied to a linear phase bandpass filter and to a pair of balanced mixers where it is mixed with a 768-kHz frequency from a VCXO operating as a Costas phase-locked loop to detect the 1-kb/sec PSK/PCM data. The PSK/PCM data is fed either direct or through a linear phase low-pass filter to two amplifiers to provide two 1-kb/sec PSK/PCM data outputs.

5.2.6.5 The inputs to each of the respective subcarrier channels are level controlled to provide a sufficient signal for each channel to operate. The two outputs of each channel can be level controlled to provide sufficient signal for external equipment. The 597- and 768-kHz channels each have I and IQ LOOP MONITOR outputs for monitoring loop lock conditions of the phase locked loops on an oscilloscope. Figure 5-8 is a block diagram of the Landsat subcarrier demod and table 5-6 lists the front-panel control functions.

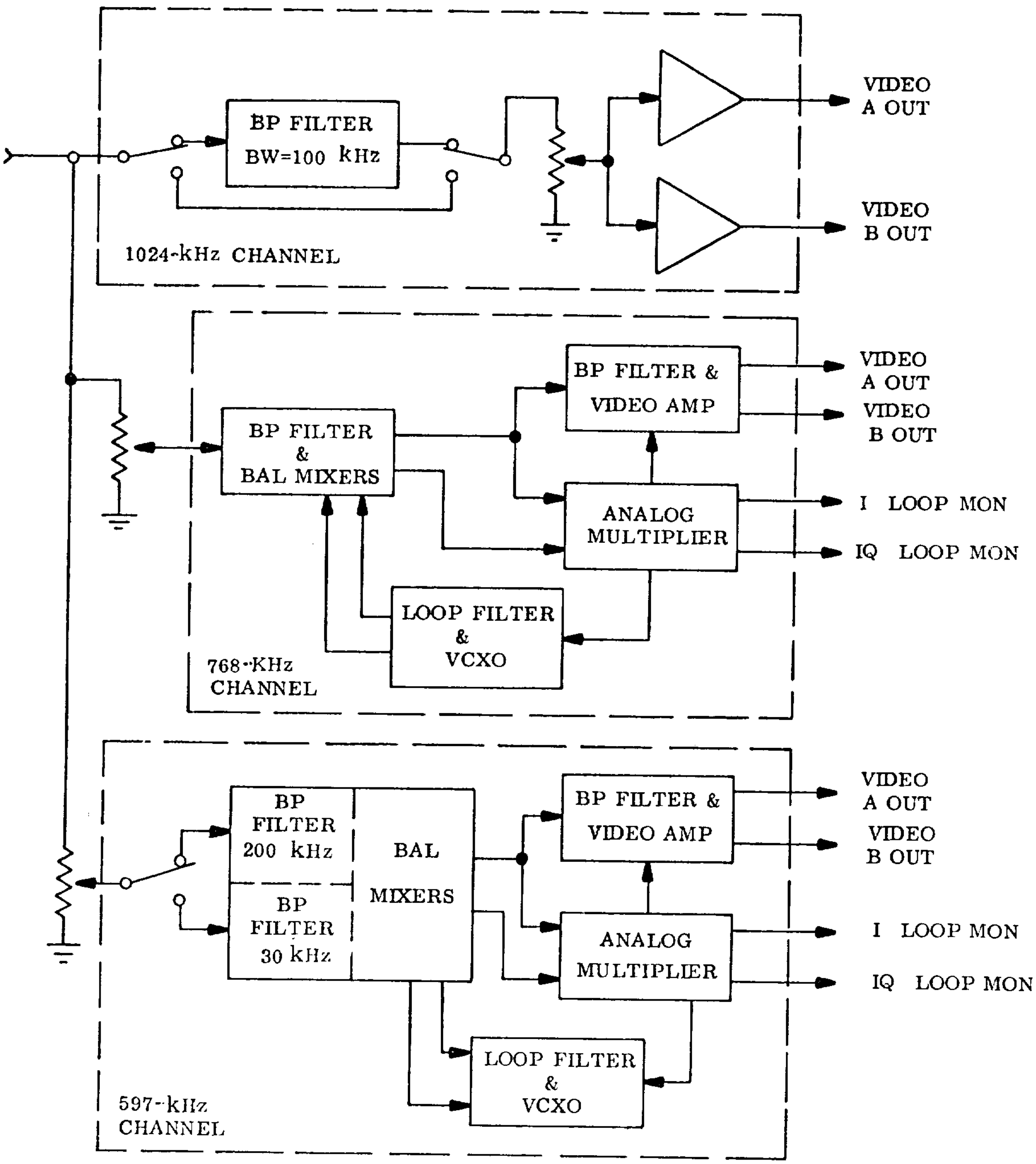


Figure 5-8. Landsat Subcarrier Demodulator Block Diagram

Table 5-6. Landsat Subcarrier Demodulator Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies 115 Vac primary.
597 KHZ B_L HZ switch	100 HZ 10 HZ	Selects one-sided loop noise bandwidth.
597 KHZ TUNING MODE switch	LOOP OPEN ACQ	Opens or completes the phase-locked loop to lock the oscillator to the incoming 597-kHz signal.
597 KHZ TUNING control	Variable	Varies the frequency of the 597-kHz oscillator when the loop is open or unlocked.
▼597 KHZ BPS switch	30 KHZ 200 KHZ	Selects bandpass filter for 1-kb data. Selects bandpass filter for 24-kb data.
597 KHZ INPUT LEVEL control	Variable	Varies the input signal level to the 597-kHz channel.
▼597 KHZ VIDEO BW KHZ switch	1.5 KHZ 2.5 KHZ 36 KHZ 60 KHZ DIRECT	Selects data bandwidth from demodulated signal at the input to the video amplifier. In DIRECT position,signal is applied directly to the video amplifier.
597 KHZ OUTPUT LEVEL control	A B	Varies output signal for the two separate video amplifiers to level required to drive external processing equipment.
768 KHZ B_L HZ switch	100 HZ 10 HZ	Selects one-sided loop noise bandwidth.
768 KHZ TUNING MODE switch	LOOP OPEN ACQ	Opens or completes the phase-locked loop to lock the oscillator to the incoming 768-kHz signal.
768 KHZ TUNING control	Variable	Varies the frequency of the 768-kHz oscillator when the loop is open or unlocked.
768 KHZ INPUT LEVEL control	Variable	Varies the input signal level to the 768-kHz channel.
▼768 KHZ VIDEO BW KHZ switch	1.5 KHZ 2.5 KHZ DIRECT	Selects data bandwidth from the demodulated 768-kHz signal at the input to the video amplifier. In DIRECT position,signal is applied directly to the video amplifier.
768 KHZ OUTPUT LEVEL control	A B	Varies output signal for the two separate video amplifiers to level required to drive external processing equipment.

▼ Specified in NOSP.

Table 5-6. Landsat Subcarrier Demodulator Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Position	Purpose
▼ 1024 KHZ FILTER switch	FILTERED UNFILTERED	Controls bandpass filter on the input of the 1024-kHz channel.
1024 KHZ OUTPUT LEVEL control	A B	Varies the output signal for the two separate output amplifiers to level required to drive external processing equipment.
TUNING METER SELECT switch	597 KHZ 768 KHZ 1024 KHZ	Selects either of the oscillators in the phase-locked loops for monitoring by the tuning meter.
LEVEL METER SELECT switch	597 KHZ 768 KHZ 1024 KHZ	Selects which input signal is being monitored on the input level meter.

▼ Specified in NOSP.

5.2.7 MULTISPECTRAL SCANNER

5.2.7.1 General. The Landsat Multispectral Scanner (MSS) data downlink is processed by a demultiplexer which operates on the data and clock signals of the Monitor 319 Bit Synchronizer. The characteristics of the MSS downlink are as follows:

a. Bit rate: 15.06 Mb/SEC.

b. Code type: NRZ-L.

c. Word length: Six bits, MSB first (data bits 3 and 4 are inverted by the satellite multiplexer and restored in the demultiplexer).

5.2.7.2 Telemetry Format Description. The spacecraft contains five sensors. Sensors 1 through 4 each contain six 6-bit data words. Sensor 5 contains two data words plus a 6-bit sync code that is sent in complement form at every other sampling. Data sensing by row is shown in figure 5-9. Sensor 5 outputs are MNFS, WD 25, WD 26, and $\overline{\text{MNFS}}$ sequentially. All other sensor data outputs are generated in row sequence. Six rows constitute one minor frame and approximately 630 minor frames are included in one major frame. A major frame produces six image scan lines of the earth approximately 100 miles wide. Approximately 4300 scan lines are required to produce a video image 100 miles square.

a. Preamble Code. The data file begins with a unique 6-bit word sync pattern repeated approximately 1313 times (11.5 milliseconds).

b. Start Scan Code. The preamble is followed by a single 6-bit start-of-scan code (SMC1) pattern indicating the start of a major frame (data field).

c. Minor Frame Sync. A 6-bit MNFS code is transmitted immediately after SMC1 and is repeated every 150 data words.

Note

> The first 49 data bits of each major frame are preempted by a satellite timing code indicating days, hours, minutes, seconds, tenths of seconds, and hundredths of seconds.

The complement form of MNFS is transmitted 75 data words after MNFS during each minor frame.

d. End Scan Code. The end of each major frame of data is indicated by a 100-word all 0's pattern followed by a 100-word all 1's pattern.

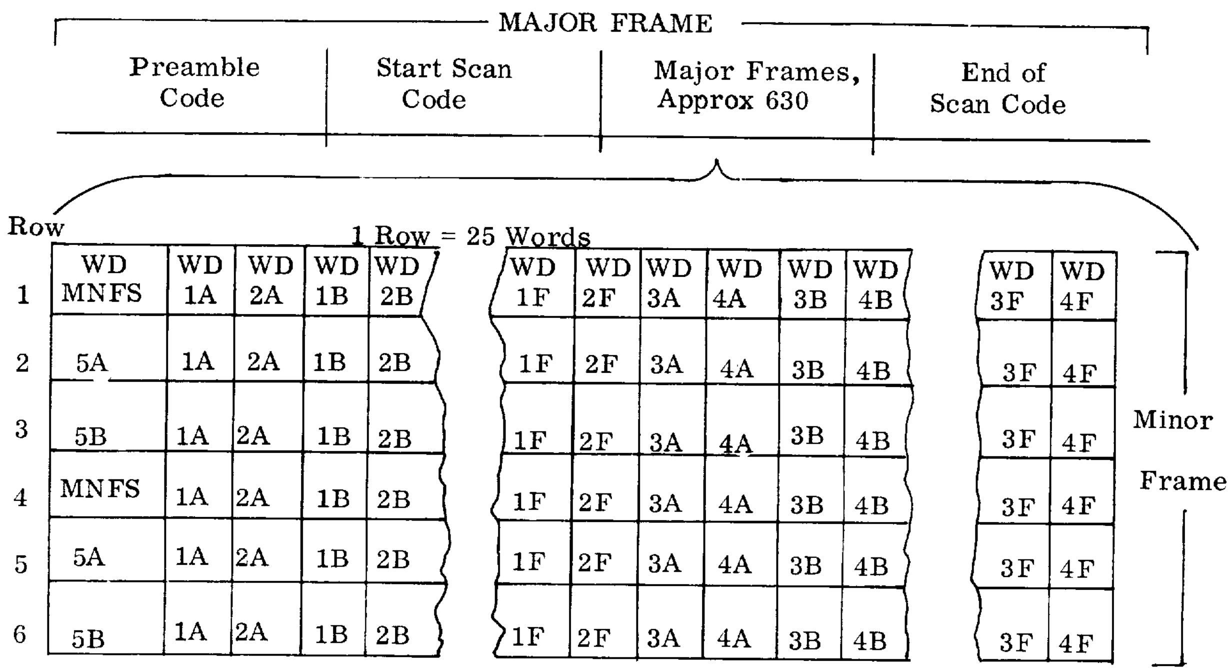


Figure 5-9. MSS Telemetry Format

5.2.7.3 Demultiplexer. The demux accepts the 15-Mb/sec bit synchronizer output, and decommutates it to 25 separate 600-kb/sec data channels for recording. Additional outputs consist of a 100-kHz tone used as the recorder servo reference, an MNFS error output used for operational testing, and a 2.5-MHz clock for general testing. The demux also has a switch-selectable digital-to-analog converter providing oscilloscope display on the analog value of any individual data channel. Figure 5-10 is a block diagram of the demultiplexer and table 5-7 shows front-panel control functions.

a. Format Synchronizer

(1) The sync subsystem contains two pattern detectors as follows:

(a) Preamble: Search/lock.

(b) MNFS: Search/lock.

(2) The sync requirements are switch selectable to any one of the four different patterns:

(a) SMC1 only.

(b) SMC1 + MNFS.

(c) Preamble + SMC1.

(d) Preamble + SMC1 + MNFS.

(3) Synchronizer operation is divided into four modes as follows:

(a) Mode 00 Preamble Search. The downlink code has not been detected or bad data is being received.

(b) Mode 01 Preamble Lock. Seven consecutive good preamble code patterns have been detected.

(c) Mode 11 Minor Frame Lock. The start-of-scan code has been detected and the demux tape formatter is processing valid data.

(d) Mode 10 Minor Frame Search Mode. If four bad MNFS patterns are detected within one major frame, the minor frame synchronizer goes to MNFS search mode and the demux will no longer be processing valid data. If MNFS is re-acquired prior to end of the major frame, the synchronizer will return to minor frame lock (mode 11) and again process valid data until the end of the major frame scan period. At that time the synchronizer reverts to mode 00 and begins searching for the preamble of the next major frame scan.

(4) Between the end of scan code and the start of the new major frame preamble, the demux determines the active scan time interval, places it on each output channel, and provides it as a front-panel binary display.

b. Tape Formatter. This section accepts the 15-Mb/sec clock output of the bit synchronizer and divides it to provide bit counting and sync generation. Decommutation is accomplished in this section by sequentially shifting six bits into 25 six-bit shift registers at 15 Mb/sec and serially shifting each register out at 600 kb/sec to produce the 25 individual channels.

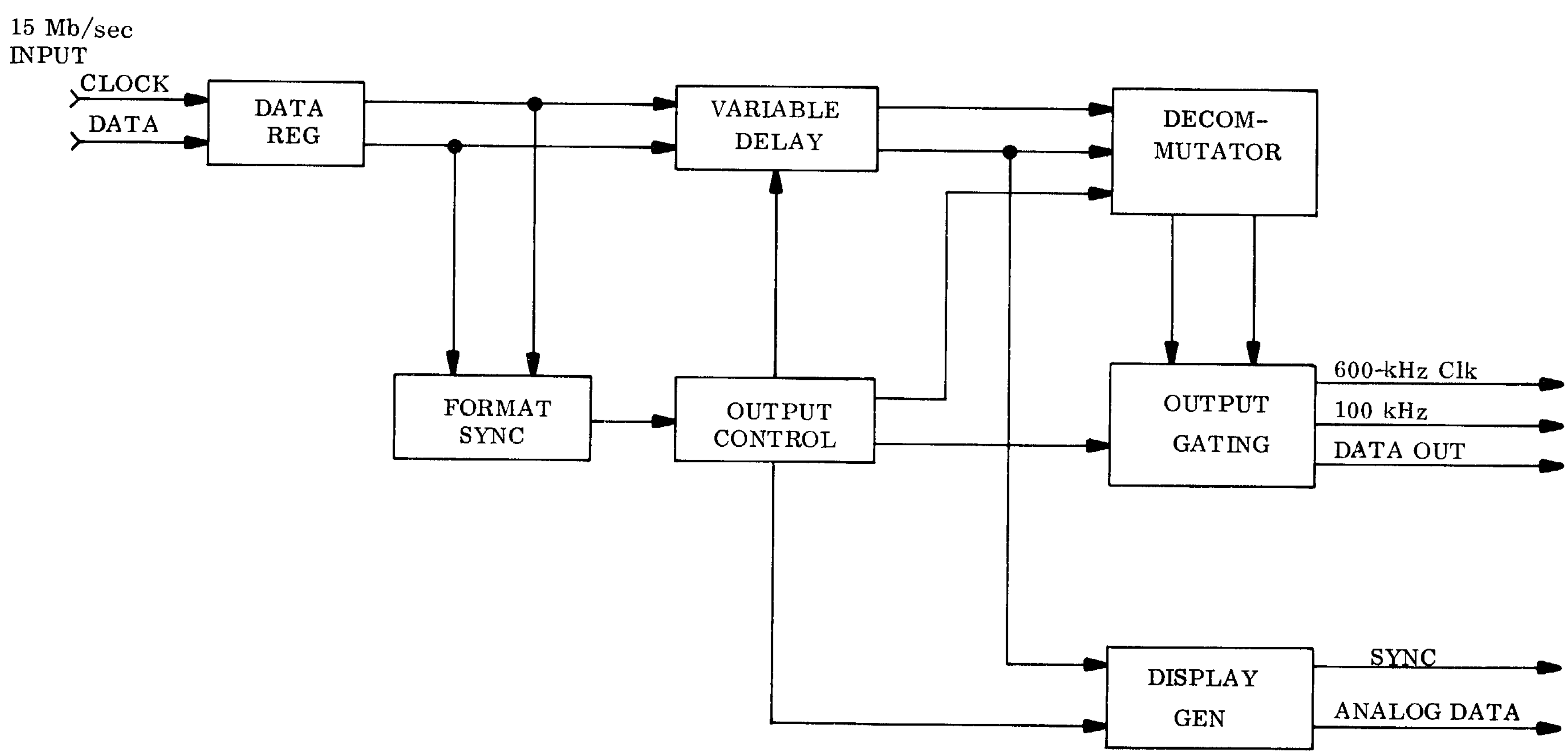


Figure 5-10. MSS RSE Demultiplexer Block Diagram

Table 5-7. MSS RSE Demultiplexer Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to unit.
PHASE switch	NORMAL INVERT	Inverts data.
▼ DELAY switch	IN OUT	Inhibits SMC1 detector until 100 μsec before end of scan.
CHANNEL SELECT switch	1 - 26	Selects analog display of individual channels.
▼ SYNC SELECT switch	1) SMC 1 2) SMC 1 + MNFS 3) PRE-AMBLE + SMC 1 4) PRE-AMBLE + SMC 1 + MNFS	Selects sync pattern requirements for valid data processing.

▼ Specified in NOSP.

c. Display Generator. This section contains the six-bit digital-to-analog converter. Channel selection is provided by a 26-position switch on the demux front panel. The converter output (0 to +5 V) provides a voltage proportional to the binary representation of the selected word.

d. Power Supplies. Power supplies for this unit consist of three regulated, self-contained units providing +5, +15, and -15 V.

5.2.8 MSS/RSE TEST SET

5.2.8.1 Operational Description. The test set is used to simulate the spacecraft 15.06-Mb/sec NRZ-L PCM output format, and to provide monitoring display of selected spacecraft sensor data and the time interval of a major frame. The test set contains front-panel switches for selecting the proper preamble, start-of-scan, minor frame, and end scan sync codes for simulating the MSS format. The selection of data word codes can be either unique or general. The unique word code can be placed in any one of 26 sensor data locations and the general word code provides the balance of the sensors with a common code pattern. Selectable oscilloscope sync trigger signals are available for monitoring the portions of the serial data. By altering the front-panel switches, the operator is able to place known errors in the serial data to test the various sync and detection logic circuits of the demultiplexers. Six digital bits representing one demultiplexed sensor data sample and the 18 bits representing the time interval measurement are displayed by indicators on the front panel. The source of the time interval measurement or the sensor word is selectable from either the demux or the FR1928 Recorder reproduce output. The selected sensor word is also routed through a digital-to-analog converter for analog presentation on an external monitor oscilloscope. Figure 5-11 is a block diagram of the MSS RSE test set and table 5-8 lists the front-panel control functions.

5.2.8.2 Equipment Description

a. Clock Source. This circuit generates all the timing required for the serial output, and either an internal oscillator or external generator is selectable. This circuit also provides an output clock that is synchronous with the output data.

b. Timing Counters and Clear Load Logic. Four counters are provided to supply the pulse envelopes for bit, word, row, and minor frame timing. The clear/load logic clears the general and unique word registers during the first three bits of the first word of a major frame, and loads the selected codes during the last three bit times.

c. Triangular Generator. The triangular waveform generator places a unique pattern in the serial output data. The generator consists of a 6-bit up/down counter/register that sequences from all 0's to all 1's and back to all 0's. The bit sequencing is at sensor sampling rate. By switch selection, the resultant 0 to +5 volt triangular waveform can be inserted in the unique word or in the general word. When placed in the general word, the code update occurs at MNFS time.

d. Code Registers. These are storage registers containing the selected preamble, start-of-scan, MNFS, unique word, and general word codes. The stored information is updated once per major frame with the exception of the unique word which is updated at the selected sensor rate.

e. Control Logic. The control logic provides proper sequencing of the preamble, start-of-scan, and MNFS/MNFS codes, and major frame timing.

f. Recorder/Demux Output Monitor. This section contains an input register plus sync and word detection logic for locating the required sensor channel selected for display. The output consists of a 6-bit data register and digital-to-analog converter for binary lamp and analog display, plus the register and logic for the 18-bit time interval display.

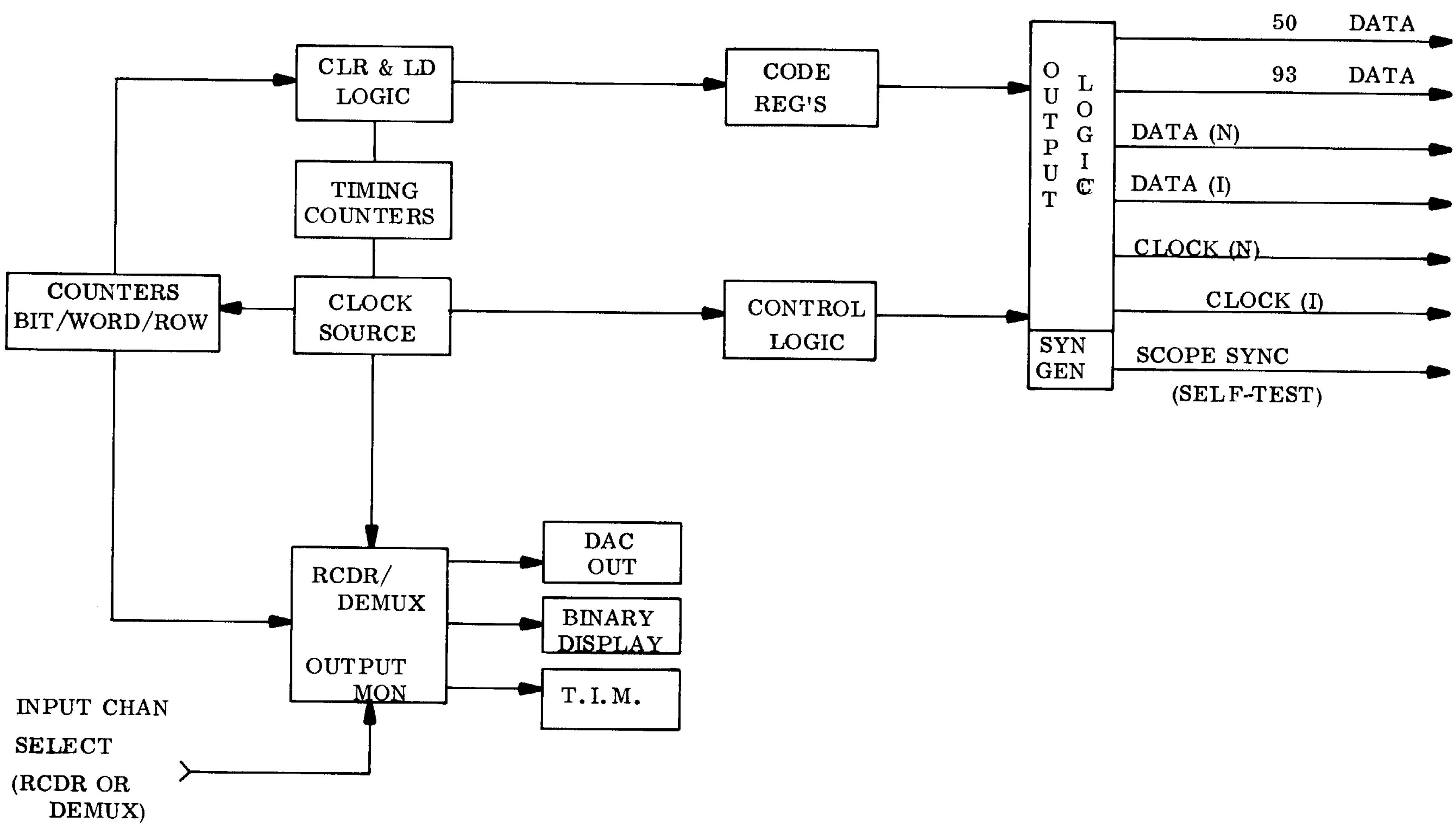


Figure 5-11. MSS RSE Test Set Block Diagram

Table 5-8. MSS RSE Test Set Front-panel Controls and Nominal Settings

Control/Indicator	Position	Purpose
POWER switch	ON OFF	Applies power to equipment.
▼5-10 MS PREAMBLE switch	10 5	Preamble duration is either 9.96 or 5.07 msec.
▼6 OR 7 GOOD PREAMBLE WORDS switch	7 6	Provides either 6 or 7 good sequential preamble code words.
▼MISS 3 OR 4 PREAMBLE WORDS switch	0 3 4	Provides either 3 or 4 incorrect preamble words after the 4 or 3 good ones.
▼MISS 3 MNFS WORDS switch	Up Down	No MNFS word is inhibited. Three MNFS words are inhibited.
▼MISS 4 MNFS WORDS switch	Up Down	No MNFS word is inhibited. Four MNFS words are inhibited.
▼MISS ALL MNFS WORDS switch	Up Down	No MNFS word is inhibited. All are missed after 10 initial MNFS.
▼PREAMBLE WORD CODE switches (6)		Program the 6-bit preamble code (000111).
▼START SCAN SYNC CODE switches (6)		Program the 6-bit SMC1 code (111000).
▼MNFS CODE switches (6)		Program the 6-bit MNFS code (001011).
UNIQUE WORD CODE switches (6)		Program a unique 6-bit code in a selected data word.
GENERAL WORD CODE switches (6)		Program a common 6-bit code pattern in all data words, except unique words.
Z-ALL/Z-UNIQUE/ -DC switch	Z-ALL Z-UNIQUE -DC	Inserts a dynamic code pattern in the unique word (Z-unique), or general word (Z-all) or disables it (-DC).
▼ALL BLACK CODE switch	NORM 15 14	Inserts 100, 15, or 14 uniquely coded 6-bit words (000000).
1 BIT ERROR (BLACK) switch	0 1	Inserts one bit error in the all-black code
▼ALL WHITE CODE switch	NORM 3 2 2-B-1	Inserts 100, 3, or 2 uniquely coded 6-bit words, or sequentially 2 white, 1 black, and 1 white 6-bit word (111111).
1 BIT ERROR (WHITE) switch	0 1	Inserts one bit error in the all-white code.

▼ Specified in NOSP.

Table 5-8. MSS RSE Test Set Front-panel Controls and Nominal Setting (cont)

Control/Indicator	Position	Purpose
UNIQUE SENSOR switch	1 - 26	Selects sensor channel for unique word coding.
SENSOR CHANNEL switch	1 - 26	Selects word for analog display.
INPUT SOURCE switch	DEMUX TAPE	Selects data display source clock.
CLOCK SOURCE switch	INT EXT	Selects 15-Mb/sec clock source from either an internal xtal or an external generator.
VARIABLE DELAY ADVANCE PB		Places one bit delay in demux output data.
DSSSC switch	In Out	When in, displaces preamble envelope 110 μsec.
SELF-TEST SYNC switch	1 - 10 1) First frame word 2) First preamble word. 3) Start scan code 4) MNFS 5) $\overline{\text{MNFS}}$ 6) All black 7) All white 8) Unique word 9) Spare 10) Spare	Used to provide scope synchronizing pulses.

5.2.9 SHUTTLE DELTA MODULATION SYSTEM

5.2.9.1 Functions and Characteristics

a. The Delta Modulation System (DMS) is part of the voice communication link between the Shuttle vehicle and ground control. It provides the necessary encoding and decoding of the digital voice multiplexed in the normal Shuttle uplink and downlink PCM data streams.

b. Uplink multiplexing functions are performed external to the DMS by Shuttle Command Voice Mux/Demux (SCVM) as shown in figure 5-12 (refer to ME-6656 for a detailed description of the SCVM). Multiplexed uplink bit rates are 72 and 32 kb/sec (see figure 5-13). Downlink is multiplexed in the Shuttle at bit rates of 192 and 96 kb/sec (see figure 5-14).

c. The DMS can modulate (analog-to-digital) and demodulate (digital-to-analog) voice at PCM rates of 32 or 24 kb/sec.

d. Uplink/downlink demultiplexing functions are performed by the DMS, while the required synchronization is performed by the 330 bit syncs and 403 frame syncs (see figure 5-12).

e. The modification of the input selector/demultiplexer chassis provides extraction of 128 or 64 kb/sec telemetry data to the CCM computer control multiplexer located at NGT and TUL.

f. Refer to table 5-9 for DMS characteristics and to ME-7173 for a detailed description of the DMS.

5.2.9.2 Subsystems

a. The Shuttle DMS consists of the following subsystems:

(1) Signal conditioning and synchronization (two per system, 330 bit sync and 403 frame sync).

(2) Input selection and demultiplexer (one per system, input select and two-channel demultiplexer).

(3) Demodulator (two per system, four channels).

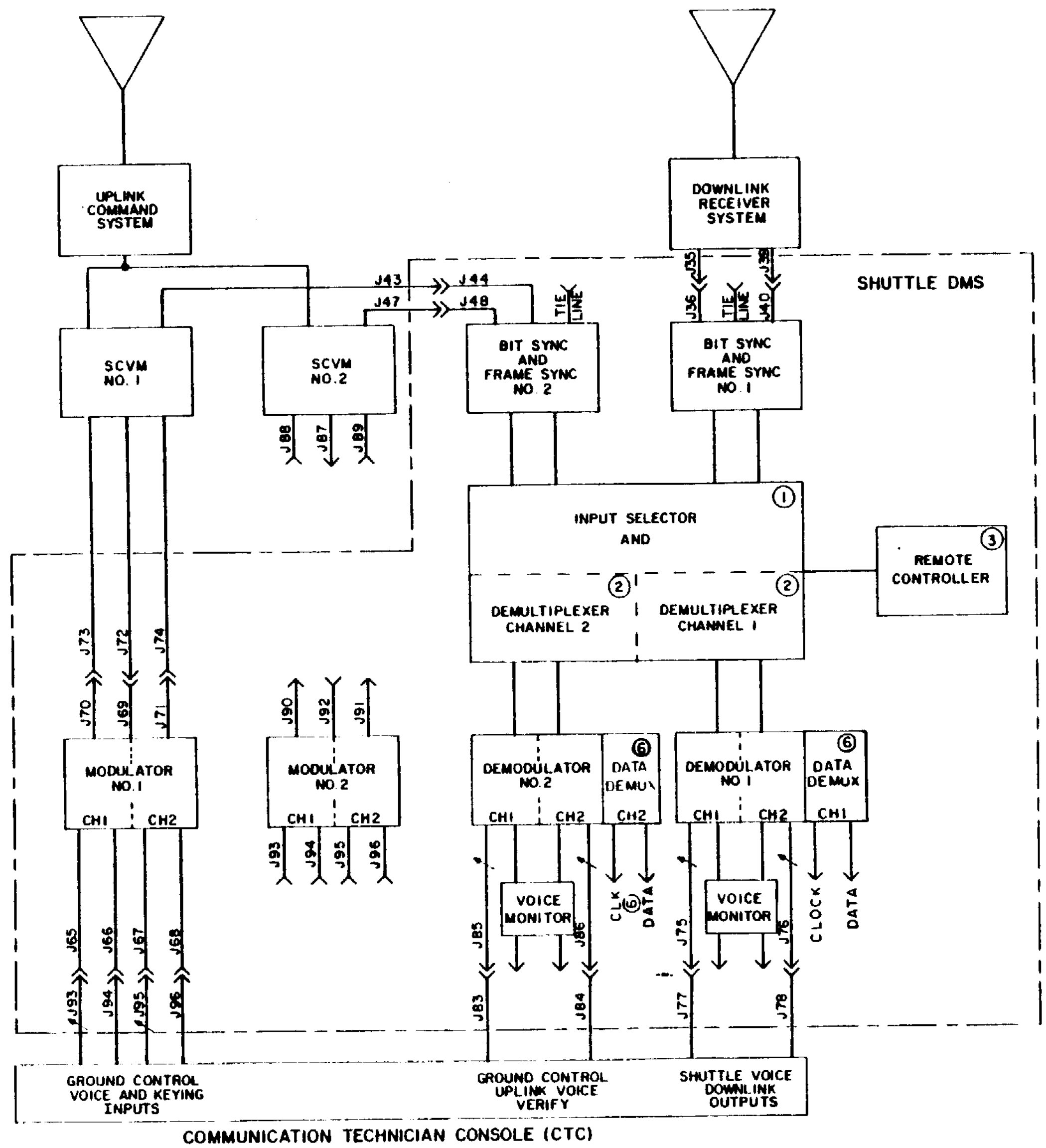
(4) Modulator (two per system, four channels).

(5) Voice monitor (two per system, four channels).

(6) Remote controller (one per system).

(7) Data demux (two per system).

b. Also provided as part of the Shuttle DMS is a 96-jack DMS patchpanel enabling full contingency patching in addition to normal operational patching and testing. For testing, four data generator SOU data and clock signals, as well as tie lines, are available.



NOTE

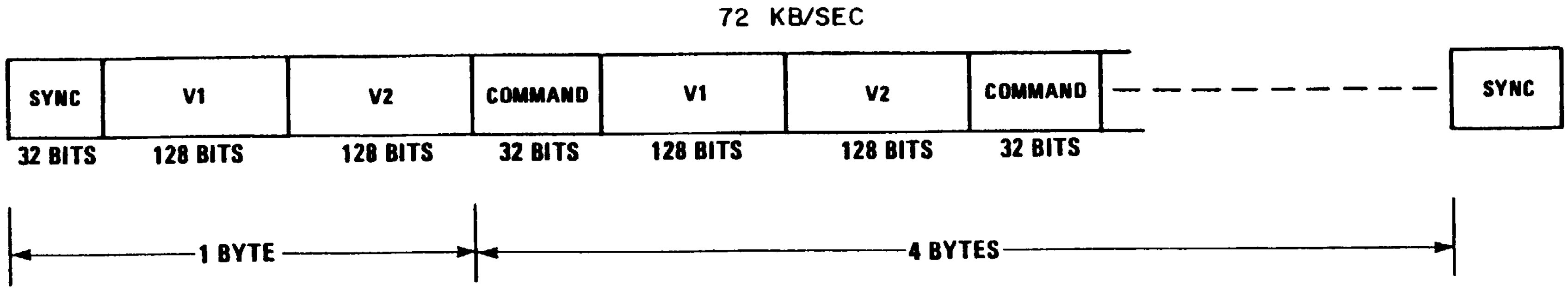
1. SELECT REMOTE SETUP.
2. SELECT CHANNEL 1 AND CHANNEL 2 INPUTS FROM FRAME SYNC'S.
3. SELECT CHANNEL 1 AND CHANNEL 2 FORMATS:
   - FORMAT 1 = 192 KB/SEC DOWNLINK (V1 AND V2)
   - FORMAT 2 = 96 KB/SEC DOWNLINK (V1 ONLY)
   - FORMAT 3 = 72 KB/SEC UPLINK (V1 AND V2)
   - FORMAT 4 = 32 KB/SEC UPLINK (V1 ONLY)
4. = OPERATIONAL PATCHES AT DMS PATCHPANEL.
5. REFER TO TABLE 5-16 FOR OTHER SIGNALS AVAILABLE AT THE DMS PATCHPANEL.
6. NGT, TUL ONLY

Figure 5-12. Simplified Block Diagram, Shuttle Voice Uplink and Downlink

5.2.9.3 SCVM Locations

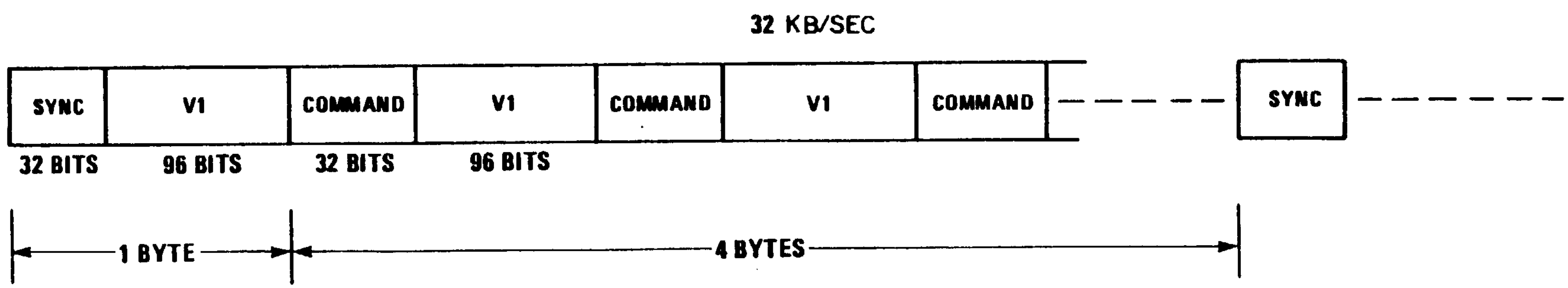
a. Two DMS's are at MIL. Interface and patchpanels are such that DMS 1 is normal to SCVM 1, and DMS 2 is normal to SCVM 2. The tie line interface for DMS 1 and DMS 2 enables contigency cross-patching between the DMS's and SCVM's.

b. SCVM 2's are not available at AGO, BDA, GWM, and HAW.



V1 AND V2 BIT RATE – 32 KB/SEC

FORMAT 3

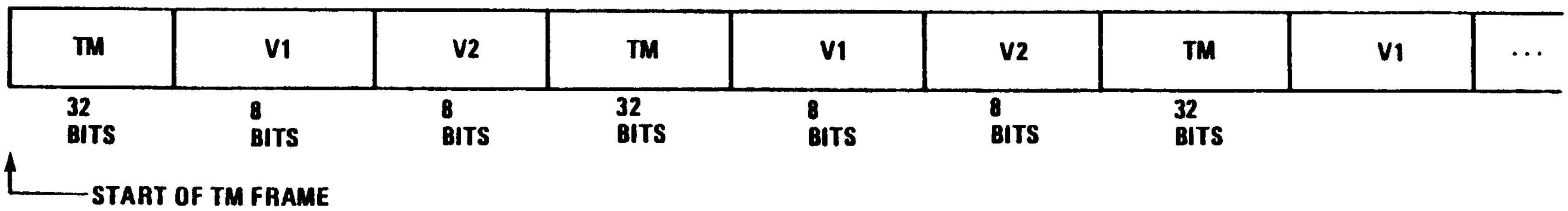


V1 BIT RATE – 24 KB/SEC

FORMAT 4

Figure 5-13. Shuttle Uplink Formats

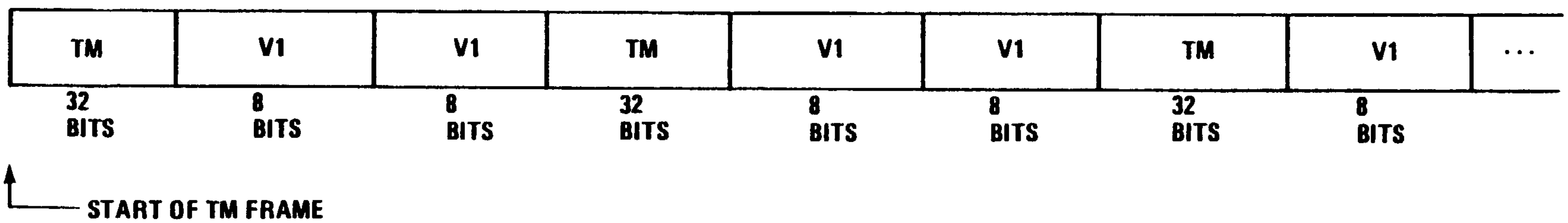
192 KB/SEC



EACH TM FRAME WILL CONSIST OF:
- 40 32-BIT BLOCKS OF TM DATA (ONE FRAME)
- 40 8-BIT BLOCKS OF VOICE 1 (V1)
- 40 8-BIT BLOCKS OF VOICE 2 (V2)
- V1 AND V2 BIT RATE – 32 KB/SEC

FORMAT 1

96 KB/SEC



EACH TM FRAME WILL CONSIST OF:
- 20 32-BIT BLOCKS OF TM DATA (ONE FRAME)
- 40 8-BIT BLOCKS OF VOICE 1 (V1)
- V1 BIT RATE – 32 KB/SEC

FORMAT 2

Figure 5-14. Shuttle Downlink Formats

Table 5-9. DMS Characteristics

Parameter	Characteristic
Internal Dc Operating Voltages	+5 Vdc, +24 Vdc ±15 Vdc
Input/Output (I/O) Logic Levels	Logic 1: 3.75 ±0.25 Vdc Logic 0: 0.0 ±0.5 Vdc
Rise/Fall Time	150 nsec, maximum
Termination Impedance	Serial I/O: 50 ohms Parallel I/O: 120 ohms
Clock	1.53 MHz 32 kHz 24 kHz 192, 96, 72, 32 kHz
Memories	16 X 4 RAM 32 X 8 PROM 256 X 4 PROM
Audio	Remote output: 600 ohms, balanced and adjustable from -20 to +10 dBm 50 ohms, unbalanced and adjustable from 0.5 V to 1.5 Vrms Local output: 2.5 W rms into 8 ohms.
Data	128 kb/sec NRZ, 64 kb/sec NRZ
Clock	128 kHz, 64 kHz

Table 5-9A. Data Rate Versus Format

Format	Formatted Data Rate (kb/sec)	Telemetry Data Rate (kb/sec)	Voice Data Rate (kb/sec)
1	192	128	32 V1, V2
2	96	64	32 V1
3	72		32 V1, V2
4	32		24 V1

5.2.9.4 Operation

a. The uplink ground control voice 1 or voice 2 received from the CTC, along with voice 1 or voice 2 keying, is patched at the DMS patchpanel to the desired DMS modulator. By abate delta modulation, the analog voice is converted to a serial digital data stream. The digital voice is normally clocked by an external clock (32 or 24 kb/sec) from the SCVM system. At the DMS, digital voice is patched to the SCVM for multiplexing with the uplink command data. A detected uplink verification signal, fed back from the SCVM to the DMS, is conditioned and synchronized before demultiplexing. The 32- or 24-kb/sec demultiplexed digital voice is demodulated by the abate delta demodulator. The demodulated analog voice is made available at the appropriate DMS voice monitor channel, and is patched back to the CTC for recording or monitoring. Downlink digital voice is processed in the same manner as the uplink voice verification signal and patched to the CTC for remoting voice.

b. The modified IS/DX unit located at NGT and TUL can extract and output telemetry data and clock in formats 1 and 2. The unit does not provide telemetry data and clock if the frame sync is lost or if format 3 or 4 is selected.

c. Contingency operation can be effected at the DMS input selector or patchpanel to provide backup in case of equipment failure. Readily available are the spare two-channel modulator for uplink backup and the complete uplink verification channel for downlink backup. In the latter case, uplink verify capabilities are lost.

d. For normal operational patching, refer to table 5-9. Refer to tables 5-10 through 5-14 for front-panel controls and nominal settings. Refer to tables 5-15 and 5-16 for complete list of available signals and positions at the DMS patchpanel.

Table 5-10. MX-5235 Remote Controller Front-panel Controls and Nominal Settings

Control/Indicator	Description	Purpose
LAMP TEST	Toggle switch, spring return	Provides for simultaneous test of all remote controller indicators.
CHANGE	Toggle switch, spring return	Initiates signal for change to selected format.
▼ FORMAT	Four-position thumbwheel switch	Selects desired format.

▼Specified in NOSP.

Table 5-10. MX-5235 Remote Controller Front-panel Controls and Nominal Settings (cont)

Control/Indicator	Description	Purpose
SELECTED	Seven-segment LED numeric	Displays selected format (only when input selector/demultiplexer REMOTE/LOCAL switch for that channel is set to REMOTE).

Table 5-11. MX-5231 Input Selector/Demultiplexer Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position/Description	Purpose
LAMP TEST		Provides simultaneous test of all indicators on front panel.
POWER ON	ON OFF	Applies or removes 115-Vac power.
RESET	Toggle switch, spring return	Silences audio alarm and resets MODE visual alarm.
▼INPUT	Four-position thumbwheel switch	Selects desired frame sync input.
▼SELECT	Four-position thumbwheel switch	Programs unit for format selection when in local mode.
▼REMOTE/LOCAL	REMOTE LOCAL	Selects remote controller or local format programming.
▼LSB/MSB	LSB MSB	Selects serial output data bit orientation of each channel.
TEMP indicator	LED (red)	Indicates overtemperature condition.
MODE indicator	LED (red)	Indicates use of remote controller when REMOTE/LOCAL switch is set to LOCAL, or failure of the remote controller processor to process a complete instruction cycle.
POWER indicator	LED (green)	Indicates 115 Vac is applied to the unit.
REMOTE indicator	Seven-segment LED	Indicates selected format when in remote mode.
▼Specified in NOSP.		

Table 5-12. MX-5232 Modulator Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position/Description	Purpose
▼CLOCK	Toggle switch, INT EXT	Selects internal or external clock.
KEY INH	Toggle switch, INH	When set to INH, prevents keying circuits from disabling the digitizing function.
INPUT	Toggle switch, 600Ω 50 Ω	Selects either 50-ohm or 600-ohm inputs.
POWER	Toggle switch, ON OFF	Applies 115 Vac to the chassis.
▼PROCESSOR	Toggle switch, IN OUT	Bypasses clipping and Automatic Gain Control (AGC) circuits when set to OUT.
LAMP TEST	Toggle switch, spring return	Simultaneous test of all indicators.
▼DATA RATE	Toggle switch, 24 32	When internal clock is used, selects either 24 or 32 kb/sec rate.
POWER indicator	LED (green)	Indicates application of 115 Vac to the chassis.
BYPASSED indicator	LED (red)	Indicates bypassing of clipping and AGC circuits.
LEVEL (dBm) indicator	LED (three-position)	When INPUT is set to 600Ω, shows level of analog input signal from -20 to +10 dBm.

▼Specified in NOSP.

Table 5-13. MX-5233 Demodulator Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position/Description	Purpose
POWER ON	Toggle switch, <u>ON</u>	Applies 115 Vac to unit.
OUTPUT, 50-OHM	Potentiometer, as required	Adjusts amplitude of analog signal output at 50-ohm connector.
OUTPUT 600-OHM	Potentiometer, adjustable for 0 ohm on LED display.	Adjusts amplitude of analog signal output at 600-ohm connector.
▼FILTER	Toggle switch, INT EXT	Selects internal or external filter.
SQUELCH	Toggle switch, INH <u>Down</u>	Disables squelch circuit when set to INH.
TONE	Toggle switch, INH <u>Down</u>	Disables 1-kHz out-of-lock tone when set to INH.
INPUT	Toggle switch, 1 <u>2</u>	Selects desired input for each channel: input 1 (hard-wire), input 2 (patchpanel).
LAMP TEST	Toggle switch, spring return	Provides simultaneous test of all indicators on front panel.
POWER indicator	LED (green)	Indicates 115 Vac applied to the chassis.
LOCK, IN indicator	LED (green)	Indicates frame sync is in lock. Lock status symbol 1 causes indicator to light, 0 extinguishes it.
LOCK, OUT indicator	LED (red)	Indicates frame sync is out of lock. Lock status of 0 causes indicator to light, 1 extinguishes it.
▼Specified in NOSP.		

Table 5-14. MX-5234 Voice Monitor Front-panel Controls, Indicators, and Nominal Settings

Control/Indicator	Position/Description	Purpose
POWER	Toggle switch, ON	Applies 115 Vac to the chassis.
OUTPUT ON	Toggle switch, as required	Off-on control for individual channel.
OUTPUT LEVEL	Potentiometer, as required	Level control for output audio signal.
INPUT	Toggle switch, 1 2	Selects desired input for each channel: input 1 (hard-wire), input 2 (patchpanel).
POWER indicator	LED (green)	Indicates application of 115 Vac to the chassis.

Table 5-15. Shuttle DMS Front-panel Nominal Patching

From - To Patching	Signal Function
J79 ↔ J65	Ground control analog voice 1
J80 ↔ J66	Ground control analog voice 1 keying
J81 ↔ J67	Ground control analog voice 2
J82 ↔ J68	Ground control analog voice 2 keying
J72 ↔ J69	SCVM 1 clock out
J70 ↔ J73	32 or 24 kb/sec digital voice 1
J71 ↔ J74	32 kb/sec digital voice 2
J43 ↔ J44	SCVM 1 uplink verify
J47 ↔ J48*	SCVM 2 uplink verify
J35 ↔ J36	192 or 96 kb/sec Telemetry Data Modulation (TDM), prime data
J39 ↔ J40*	192 or 96 kb/sec TDM, backup data
J75 ↔ J77	Downlink analog voice 1
J76 ↔ J78	Downlink analog voice 2
J85 ↔ J83	Uplink analog voice 1
J86 ↔ J84	Uplink analog voice 2
* Contingency patching	

Table 5-16. Shuttle DMS Patchpanel Positions

Position	Function	Position	Function
J1	Modulator 1, output 2, data channel 1	J18	Modulator 1, channel 2 input (50 ohms)
J2	Modulator 1, output 2, clock channel 2	J19	Modulator 2, channel 1 input (50 ohms)
J3	Data generator data bus 1, serial data A in	J20	Modulator 2, channel 2 input (50 ohms)
J4	Data generator data bus 1, serial data B in	J21	Flywheel output frame sync 1
J5	Modulator 1, output 2, data channel 2	J22	Flywheel output frame sync 2
J6	Modulator 1, output 2, clock channel 2	J23	Reserved for SCVM 1 return clock
J7	Data generator data bus 2, serial data A in	J24	Reserved for SCVM 2 return clock
J8	Data generator data bus 2, serial data B in	J25	Telemetry tie line 3
		J26	Telemetry tie line 4
J9	Modulator 2, output 2, data channel 1	J27	Telemetry tie line 5
J10	Modulator 2, output 2, clock channel 1	J28	Telemetry tie line 6
		J29	Voice monitor 1, input 2, channel 1
J11	Data generator CLK÷N 0°, SOU 0	J30	Voice monitor 1, input 2, channel 2
J12	Data generator CLK÷N 0°, SOU 1	J31	Voice monitor 2, input 2, channel 1
J13	Modulator 2, output 2, data channel 2	J32	Voice monitor 2, input 2, channel 2
J14	Modulator 2, output 2, clock channel 2	J33	Demodulator 1, input 2, data channel 1
J15	Data Generator CLK÷N 0°, SOU 2	J34	Demodulator 1, input 2, clock channel 1
J16	Data generator CLK÷N 0°, SOU 3	J35	Telemetry tie line 1
J17	Modulator 1, channel 1 input (50-ohms)	J36	330 bit sync 1, input 1

Table 5-16. Shuttle DMS Patchpanel Positions (cont)

Position	Function
J37	Demodulator 1, input 2, data channel 2
J38	Demodulator 1, input 2, clock channel 2
J39	Telemetry tie line 2
J40	330 bit sync 1, input 2
J41	Demodulator 2, input 2, data channel 1
J42	Demodulator 2, input 2, clock channel 1
J43	SCVM 1 uplink verify out
J44	330 bit sync 2, input 1
J45	Demodulator 2, input 2, data channel 2
J46	Demodulator 2, input 2, clock channel 2
J47	SCVM 2 uplink verify out
J48	330 bit sync 2, input 2
J49	Demux 1, voice 1, data
J50	Demux 1, voice 1, clock
J51	Data generator data bus 1, serial clock A in
J52	Demux 1, voice 2, data
J53	Demux 1, voice 2, clock
J54	Data generator data bus 2, serial clock A in
J55	Demux 2, voice 1, data
J56	Demux 2, voice 1, clock
J57	Data generator data bus 1, serial clock B in
J58	Demux 2, voice 2, data
J59	Demux 2, voice 2, clock
J60	Data generator data bus 2, serial clock B in
J61	Demodulator 1, output 2, channel 1 (50 ohms)
J62	Demodulator 1, output 2, channel 2 (50 ohms)
J63	Demodulator 2, output 2, channel 1 (50 ohms)
J64	Demodulator 2, output 2, channel 2 (50 ohms)
J65	Modulator 1, voice 1 in, channel 1 (600 ohms)
J66	Modulator 1, key 1 in, channel 1 (600 ohms)
J67	Modulator 1, voice 2 in, channel 2 (600 ohms)
J68	Modulator 1, key 2 in, channel 2 (600 ohms)
J69	Modulator 1, clock in, channels 1 and 2
J72	Modulator 1, digital voice 1 out
J71	Modulator 1, digital voice 2 out
J72	SCVM 1 clock out
J73	SCVM 1 digital voice 1 in
J74	SCVM 1 digital voice 2 in
J75	Demodulator 1, analog voice 1 out (600 ohms)
J76	Demodulator 1, analog voice 2 out (600 ohms)

Table 5-16. Shuttle DMS Patchpanel Position (cont)

Position	Function	Position	Function
J77	CTC analog voice 1, downlink	J88	SCVM 2 digital voice 1 in
J78	CTC analog voice 2, downlink	J89	SCVM 2 digital voice 2 in
J79	CTC analog voice 1 out	J90	Modulator 2, digital voice 1 out
J80	CTC keying voice 1 out	J91	Modulator 2, digital voice 2 out
J81	CTC analog voice 2 out	J92	Modulator 2, clock in channels 1 and 2
J82	CTC keying voice 2 out	J93	Modulator 2, voice 1 in channel 1 (600 ohms)
J83	CTC analog voice 1, uplink verify	J94	Modulator 2, key 2 in channel 1 (600 ohms)
J84	CTC analog voice 2, uplink verify	J95	Modulator 2, voice 2 in channel 2 (600 ohms)
J85	Demodulator 2, analog voice 1 out (600 ohms)	J96	Modulator 2, key 2 in channel 2 (600 ohms)
J86	Demodulator 2, analog voice 2 out (600 ohms)		
J87	SCVM 2 clock out		

SECTION 6. TYPICAL SUPPORT ACTIVITIES

SECTION 6. TYPICAL SUPPORT ACTIVITIES

6.1 GENERAL

The basic equipment configuration outlined in this section may be used for mission support unless otherwise directed by the applicable mission Network Operations Support Plan (NOSP). Mission-unique equipment settings are specified in the mission NOSP; in the event of conflict between this document and the NOSP, the NOSP takes precedence.

6.2 TLM TYPICAL SUPPORT ACTIVITIES

6.2.1 PURPOSE

The purpose of this procedure is to provide quick reference regarding the required TLM support activities.

6.2.2 PARTICIPANTS

The following participate in TLM support:

a. TLM Supervisor.

b. Recorder Tech.

c. TLM Tech.

d. PCM Tech.

6.2.3 PROCEDURE

Typical support activities for TLM personnel are as follows:

Time	Personnel	Activities
By H-10	All	Verify that system is configured in accordance with the NOSP and mission documentation. Brief OPSR on system status. Report all Red items and ETRO.
H-10	TLM Supervisor	Monitor applicable loops. Verify that mission decom tapes are loaded and/or patching is complete, and that prepass calibrations and prepass checklist are complete. Report status to OPSR.
H-1	Recorder Tech	Recorders on (according to schedule, briefing, or NOSP).
	TLM Techs	Monitor oscilloscope for AOS.

Time	Personnel	Activities
AOS	PCM Techs	Monitor the incoming signal and report abnormal conditions to the TLM supervisor. If applicable, switch formats and bit conditioners and inform the OPSR.
LOS +2	Recorder Tech	Stop data recorders (according to schedule, briefing, or NOSP).
	TLM Supervisor	Brief OPSR on system status, report all Red items, ETRO, and AOS and LOS times, if requested.

6.3 PREPASS PROCEDURES

6.3.1 GENERAL

Prior to AOS of the spacecraft, perform the following procedures in order to provide maximum support capabilities:

a. Configure telemetry receivers in accordance with applicable NOSP.

b. Patch received signal to and from applicable receivers in accordance with desired signal path.

c. Configure decom/demod/AMQ in accordance with applicable NOSP.

d. Configure bit synchronizers in accordance with applicable NOSP.

e. Ensure correct software has been loaded into the data handling system as defined in the applicable Support Software Instruction (SSI).

f. Patch computer buffers using instructions supplied in the applicable NOSP.

g. Configure discriminators as described in the applicable NOSP.

h. Ensure that TLM mixer configurations are as defined in the applicable NOSP.

i. Configure mag tape/stripchart recorders in accordance with the applicable NOSP.

j. Perform the AGC calibration procedure as described in paragraph 6.3.2.

k. If applicable, perform system time delay measurements as described in paragraph 7.4.

6.3.2 AGC PREPASS CALIBRATION

6.3.2.1 General. Prepass calibrations are those procedures performed prior to each pass. The equipment configured for the pass is subjected to a simulated RF signal. The resulting receiver AGC signal is then recorded at mission speed (as outlined in applicable NOSP) on the stripchart recorders and magnetic tape recorders. This data is used as reference signals in analyzing actual signals received from the spacecraft.

6.3.2.2 Equipment Setup AGC Calibration

a. Configure receivers, magnetic tape recorders, and stripchart recorders as required by applicable NOSP.

b. Configure the EMR 4900 or RI 6057 FM multiplexer to the selected IRIG(s) as specified in the applicable NOSP. Refer to para 6.3.2.2d(3).

c. Using the FM multiplexer internal calibration circuits, calibrate the IRIG VCO's for 0 V to equal lower bandedge, plus 5 V to equal center frequency, and plus 10 V to equal upper bandedge.

d. At stations using MFR receivers that have not been modified by EC 2210, or using other receiver types, calibrate the VCO's as follows:

(1) Apollo Receivers (JPL). 0 V equals UBE, -5 V equals CF-10 V equals LBE (VCO, stripchart, bandedge reversal may be utilized).

(2) Microdyne 2200 Receivers. 0 V equals LBE, +5 Vquals CF, plus 10 V equals UBE. (SENSE switch on rear of receiver to be set to + position).

(3) Unmodified Receivers. Stations using unmodified MFReceivers (EC 2210 not installed) and do not have EMR 4900 or RI 6057 multiplexers are to calibrate -4 V equals LBE, 0 V equals CF, +4 V equals UBE (multiplexers to be used are at station option).

e. After calibration of selected VCO's has been accomplished, set applicable switches on RI 6057, EMR 4900, or multiplexer used to the position required for data input.

Note

Receiver AGC voltages to be patched to applicable VCO's and deviation from center frequency to be allowed to fall where it may.

f. The AGC calibration begins with an equivalent signal level of -110 dBm input to the system preamplifiers, (cable losses from CSG to preamps must be known, and CSG output adjusted to compensate for losses). At this time, adjust the appropriate stripchart recorder pen to center line of graph.

g. Input a signal of -70 dBm (or level attainable) into system pre-amplifiers (cable losses to be compensated for). Adjust stripchart pen to one grid less than maximum left deflection to correspond to this level. Decrease signal generator output to -150 dBm (or system threshold, cable losses compensated for) and adjust stripchart pen to one grid less than maximum right deflection.

Note

PM/FM thresholds will vary, however PM threshold is nominally -150 dBm; FM threshold will occur at approximately -120 dBm. Stripchart bandedge reversal may result due to equipment being used.

h. Repeat steps f and g until both limits of stripchart recorder channel reflect correct levels. (For FM cals with reduced voltage, stripchart limits may be less than full deflection minus one grid.)

6.3.2.3 Recorder Levels. For recorder levels, refer to STDN No. 502.28, Network Operations Procedures for Recorder Systems and table 6-1 of this NOP for magnetic tape recorder levels and calibration procedures.

6.4 POSTPASS PROCEDURES

6.4.1 GENERAL

Following Loss of Signal (LOS) from the spacecraft and subsequent stopping of the recorders, perform the following:

a. If postpass calibrations are required (refer to para 6.4.2) proceed with calibration with concurrence of OPSR.

b. Prepare postpass summary message (refer to STDN No. 502.16), and submit to OPSR for transmission to NOCC.

c. If spacecraft frequency was measured, inform OPSR of measured frequency for entry into PASSUM.

Table 6-1. Typical Prepass Calibration Instructions

Time Frame (minutes)	Applicability	Remarks
H-30 to H-1	All	Set the signal generator to -110 dBm, modulate the CSG (station option) with a signal of adequate frequency and modulation index to ensure correct mission configuration and adjust MTR levels (refer to paragraph 6.3.2.3). Remove modulation from the signal generator, start recorders and allow MTR to stabilize, record the -110 dBm level for 2 to 5 seconds, then continue to record the calibration step sequence in 2- to 5-second intervals as follows: -70 dBm (or level attainable), -80 dBm, -90 dBm, -100 dBm, -120 dBm, -130 dBm, -140 dBm, -150 dBm, (or level attainable), and -110 dBm to end of calibration. (For FM calibrations, -120 dBm will be nominal threshold.) Set all generators to standby; prepare for pass. If more than 2 minutes remain prior to H-0, stop recorders.
H-1		Recorders ON.
Note If prepass calibrations are not complete by H-1 seconds, discontinue, note on PASSUM, and perform postpass calibration.		

d. If quick-look report message is required, prepare in accordance with STDN No. 502.16 (PASSUM) and submit to OPSR.

e. If a postpass playback or an S/F build from an analog tape is required, perform the following:

(1) Retrieve and mount applicable analog tape.

(2) Cue analog tape to at least 10 seconds prior to tape referenced GMT of requested data start time.

(3) Configure appropriate DDPS DHE as required for support.

(4) Configure TCT system as required for support (refer to applicable sections of STDN No. 502.28 for instructions).

(5) Check all required signal flow paths for proper functionality. Ensure that data sync/decom and TCT lock on to their respective inputs and ensure valid inputs to DDPS input processing subsystem.

(6) Recue analog tape as in step 2 and inform OPSR when ready for playback.

6.4.2 POSTPASS CALIBRATIONS

Postpass calibrations are performed under the following conditions:

a. Turnaround time is too short to allow for a prepass calibration.

b. Prepass calibration was improperly performed.

c. Postpass calibration is directed by the NOSP.

d. An unscheduled (and therefore, uncalibrated) IRIG is used. Only this IRIG need be calibrated.

6.5 CONTINGENCY PROCEDURES

6.5.1 GENERAL

A condition causing a deviation from the normal sequence of prepass setup and pass operations is a contingency. These conditions may be caused by station equipment malfunction or spacecraft malfunction.

6.5.2 STATION EQUIPMENT MALFUNCTIONS

6.5.2.1 Reporting. In all cases of equipment failure, notify the NOCC by Equipment Status Report Message in accordance with STDN No. 502.16.

6.5.2.2 Standard Procedure. The contingency procedure in the case of failed station equipment is to substitute redundant equipment of identical capability. The substituted equipment must not be required for a pass during the substitution period. Sufficient redundant equipment exists in most cases to make this substitution quite straightforward. Some equipment, however, is common to all links, and redundant spares are not available. An example of this is the various switching systems (RF, receiver/recorder, and decom). It is unlikely that any of these switching systems would fail entirely. In the case of inability to connect any two particular points through one of these switching systems, the following is suggested:

a. Select a redundant piece of equipment to which the switching system can be connected.

b. Bypass the faulty switching system contact closure by installing temporary patches at the appropriate patchpanel.

c. In the case of receiver/recorder, decom switching, or project board panel system malfunction, the problem may often be bypassed by using the applicable spacecraft project board for a different link project board panel, at that panel, and loaning all the equipment originally intended for the pass (except line drivers and SCO's, but including the antenna and receivers) to the replacement link.

6.5.2.3 Alternate Procedure. In some cases where redundant equipment is in short supply and where changes in operator technique can make up for partially failed systems without deteriorating data, it may be desirable not to substitute equipment rather than upset station schedules if similar antennas are required concurrently for other passes or request cancellation of the pass. Some examples of this type of case follow:

a. A pass is scheduled for real-time transmission of data to GSFC, but required data link channel is inoperative. Take pass and record data for later transmission over data link.

b. NOSP requires recording of both raw and reconstructed data. Data handling equipment is inoperative and no spare is available. Take pass, recording raw data only, and note on PASSUM.

c. Frequency reference to receiver and other synthesizers is lost due to malfunction in station time standard. Switch RF equipment to internal frequency reference.

6.5.3 SPACECRAFT MALFUNCTION

In the case of spacecraft malfunction, it may be necessary to initiate a different station equipment configuration or equipment setup other than specified in the NOSP. The station is informed of these changes by the NOCC.

6.6 PCM SOFTWARE

6.6.1 GENERAL

Software for the MSFTP-2, MSFTP-3, Dynatronics DHS, Models 401 and 403 frame synchronizers, Model 1280 data generator, the Data Sync Setup Controller (DSSC), and LSI-11 is generated by GSFC Code 852.2 and distributed to the STDN as required for mission support and equipment operation.

6.6.2 SOFTWARE PACKAGE

6.6.2.1 General. PCM software packages for mission support may include all or part of the following:

a. Decom software tapes which program the equipment to process and distribute the input serial PCM data.

b. Simulator software tapes and/or data generator diskettes that program the equipment to generate serial PCM wavetrains which reflect the expected telemetry downlink.

c. DSSC diskettes that set up frame synchronizers to process and distribute the input serial PCM data.

d. Program listings which include core memory contents and associated addresses.

e. A TESOC containing description and special operating instructions for each program (a seperate TESOC is published for each PCM system in the STDN No. 515 series).

f. SSI provided by Code 852.2 to inform and provide direction as to the STDN as the telemetry software currently authorized for mission support.

6.6.2.2 Sequence Control Number. Each PCM software program is assigned a unique sequence control number to identify the equipment for which it is applicable. The same sequence control number (SEQ) applies to tapes, diskettes, program listings, and TESOC sequences. Control numbers are developed as follows:

a. Four digits are used to define a specific program. The numbers 0000 through 0699 and 1000 through 9999 indicate operational programs, 0700 through 0999 indicate maintenance and diagnostic programs.

b. A revision to a program is indicated by a decimal point and number following the program number. Revisions are defined as major program changes or incorporation of several errata.

c. One or two alphabetical characters following the program and revision numbers indicate the equipment to which the program applies. Table 6-2 gives the characters used for STDN equipment.

d. An errata, defined as a minor program change or special purpose change, is indicated by the addition of a letter in parentheses after the equipment designator. See figure 6-1 for an example and explanation of a sequence.

Table 6-2. Telemetry Software Sequence Numbers

Model	Designator
Decommutator	
Dynatronics MSFTP-2 Decom	0000D
Monitor MSFTP-3 Decom	0000MD
Dynatronics DHS Decom	0000DD
Monitor 401/Setup Controller	0000FR
Monitor 403/Setup Controller	0000FR
Simulator	
Dynatronics MSFTP-2 Simulator	0000S
Dynatronics DHS Simulator	0000DS
Aydin Model 1280 Data Generator	0000DG
Other	
DSSC	2000-2999SC
LSI-11	3000-3999SP

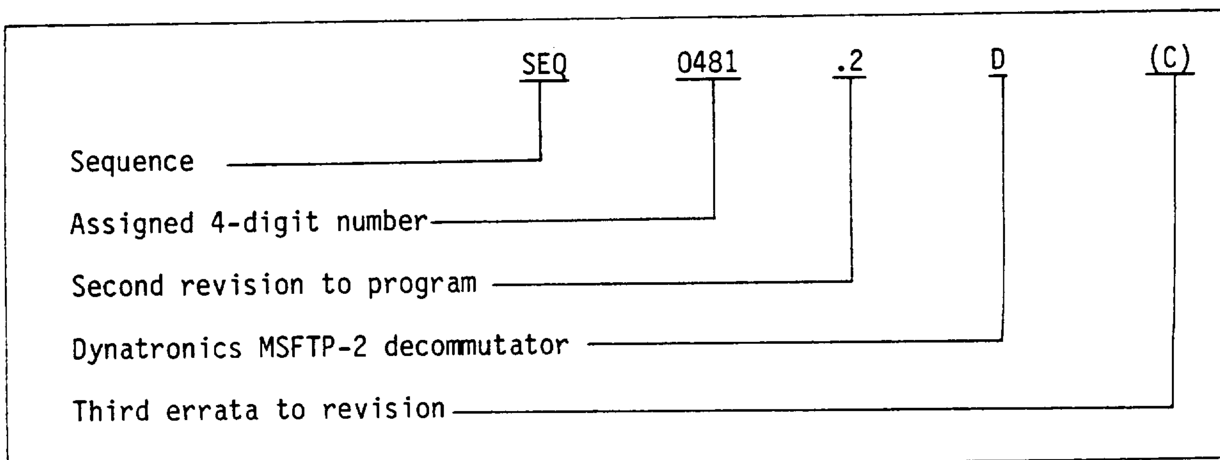


Figure 6-1. Example Sequence Number 0481.2D(C)

6.6.2.3 PCM Software Distribution. Each supporting station is sent a PCM software package pertinent to its requirement for mission support as specified in the SSI. Additional or supplemental software may be sent to any station if necessary. The complete software package minimally contains a copy of the program listing, TESOC, and program tape for each sequence number assigned. Normal procedure for supplying the STDN with software is via High-speed Data (HSD) transmission or low-speed TTY in the case of errata. Winkfield normally receives software packages by mail. An OPN message containing the basic TESOC is transmitted to the STDN, followed by mailing of the program listing.

6.6.2.4 PCM Software Receipt. Upon receipt of any PCM software, initiate the following:

a. Ascertain that the software items are station-applicable.

b. Load program tapes and errata tapes into the applicable equipment, and determine the operational condition of each tape. When the received mylar paper tapes have been verified as operationally valid, stations with tape duping facilities make a mylar copy of the tape onstation for normal operational support. The original tape should be stored or held in reserve, so a replacement tape can easily be made if the operational tape becomes damaged.

c. Add the TESOC pages to the STDN No. 515 series.

d. If the software is a revised edition or a higher level revision, discard the previous editions of the program when the complete software package (tape, listing, and TESOC) is received, verified as operationally valid, and authorized by the SSI.

6.6.2.5 Station Software Responsibilities. Stations are required to perform the following:

a. Ensure onstation availability of all applicable PCM software required for mission support as specified in the PCM decom SSI.

b. Notify NOCC by TTY upon receipt and verification of all PCM mylar/paper program and errata tapes sent to the station by any mode.

Note

Refer to STDN No. 502.16 for program/errata verification procedures.

c. Notify Code 852.2 of any deficiencies that may appear in the software.

6.6.2.6 High-speed Data Program/Errata Transmission

a. Programs or errata transmitted by High-speed Data (HSD) will be applicable only to stations equipped with Univac 642B computers. Transmission will be by SCAN Control No. 6-352.9 STUP-5.

b. The header information for these transmissions will contain the following information for the label:

(1) Sequence number.

(2) Programs/errata.

(3) Decom or sim type.

(4) Mission.

(5) Date.

c. An OPN will be sent via TTY in approximately the same time frame as the HSD transmission. The OPN will contain a brief and concise TESOC for the programs or errata sent. The listing will be distributed by mail.

6.6.2.7 Low-speed Program/Errata Transmission. Programs or errata transmitted by TTY will be sent as an OPN message. The OPN will contain a TESOC which should be placed in the station's STDN No. 515 series. A sample OPN for an MSFTP-3 errata is shown in figure 6-2. (Printed DCN's to TESOC's will be supplied each quarter.)

6.6.2.8 Manual Errata Transmission

a. Manual errata may be sent via TTY as an OPN. A manual errata will contain the information necessary to generate the errata on station. The manual errata OPN will contain a TESOC which should be placed in the station's STDN No. 515 series for use.

b. MSFTP-2 mylar errata tapes may be generated using the 1218 ASDTA program (SCAN Control No. 2-334) or PCM errata program for 642B systems, SCAN Control No. 6-358. The errata will be spliced to the end of the main program.

c. PCM/DHS errata tapes will be generated by manually loading the changes in the decom and punching a new program tape containing the basic program and the errata.

d. Manual MSFTP-3 errata will be incorporated into the basic program using the 642B DPT program (SCAN Control No. 6-348).

e. A sample of a manual MSFTP-2 errata is shown in figure 6-3.

6.6.2.9 Errata Implementation

a. Verification. All errata tapes must first be operationally verified as valid before adding them to the basic program and the superseded or deleted errata have been removed from the basic program. The program tape must be marked to show the errata level of the tape.

OPN A0000 (LANDSAT-B, OSO-I, etc.)
SUBJECT: MSFTP-3 DECOM SOFTWARE ERRATA

THIS IS ERRATA C TO SEQ 0000MD. SITE GCC PASS A COPY OF THIS MESSAGE AND TAPE TO THE TELEMETRY SUPERVISOR. THE FOLLOWING MESSAGE IS GOOD EVEN THOUGH IT APPEARS GARBLED.

FFGWEEWPTEEE (ERRATA TAPE INFORMATION)

THE FOLLOWING IS THE TESOC:

SEQUENCE: 0000MD(C)
MISSION: (LANDSAT, OSO, etc.)
DATE: 01/23/45 (date of errata)
APPLICABLE: ACN AGO BDA (as applicable)

1. GENERAL

THIS IS ERRATA C TO SEQ 0000MD. THIS ERRATA SUPERSEDES ALL PREVIOUS ERRATA. ERRATA A AND B ARE CANCELLED. THE PURPOSE OF THIS ERRATA IS TO INCORPORATE ALL PREVIOUS ERRATA AND MAKE STRIPPED WORD CHANGES IN FORMAT C.

2. SPECIAL OPERATING INSTRUCTIONS

THIS ERRATA MUST BE LOADED AFTER SEQ 0000MD FOR CORRECT OPERATION IN ALL FORMATS.

3. ERRATA DESCRIPTION

3.1 FORMAT C

A. WORD 69 IS DELETED FROM THE STRIPPED WORDS.

B. WORD 70 IS ADDED AS A STRIPPED WORD.

3.2 FORMAT D

WORD 75 IS DELETED AS A STRIPPED WORD.

4. ERRATA LISTING

ADDRESS	DATA	REMARKS
00375	01 40001 00000	DELETE WD 69
00376	01 43001 00000	ADD WD 70
01725	01 40001 00000	DELETE WD 75

END OF MESSAGE

J. DOE CODE 852.2 SENDS

Figure 6-2. Sample Low-speed OPN MSFTP-3 Errata Message

OPN A1036 OSO-I
SUBJECT: MANUAL MSFTP-2 DECOM SOFTWARE ERRATA

THIS IS ERRATA A TO SEQ 0481D. A MYLAR ERRATA TAPE MUST BE GENERATED ON STATION USING THE 1218 ASDTA PROGRAM SCAN 2-334.

CHANGE	ADDRESS	DATA (LESS PARITY)
FROM	3604	340000004262
TO	3604	340000010262

THE FOLLOWING IS THE TESOC:

SEQUENCE: 0481D(A)
MISSION: OSO-I
DATE: 05/21/76 (date of errata)
APPLICABLE: ACN AGO BDA ETC (as applicable)

1. GENERAL

THIS IS ERRATA A TO SEQ 0481D, DATED 12/02/74. THE PURPOSE OF THIS ERRATA IS TO CHANGE THE WD 10 DAC ASSIGNMENT IN FORMAT B.

2. SPECIAL OPERATING PROCEDURES

THIS ERRATA MUST BE LOADED AFTER SEQ 0481D TO PROVIDE THE CORRECT DAC ASSIGNMENTS FOR LOCAL DISPLAYS IN FORMAT B.

3. ERRATA DESCRIPTION

3.1 FORMAT B

THE DAC ASSIGNMENT FOR WORD 10 IS CHANGED FROM DAC 1 TO DAC 2.

4. ERRATA LISTING

ADDRESS	DATA (LESS PARITY)
3604	340000010262

END OF MESSAGE

J. DOE CODE 852.2 SENDS

Figure 6-3. Sample Manual MSFTP-2 Errata Message

b. TTY for MSFTP-2. Convert the paper tape, received via TTY, to 1-inch 8-level mylar tape using the 642B program PCM errata (SCAN Control No. 6-323). After the errata has been verified, it should be spliced onto the basic program or a new tape generated by 642B computer (station option). The TTY TESOC should be placed in the station's TESOC series and used until receipt of the quarterly DCN containing a new hard copy TESOC.

c. TTY for PCM/DHS. Convert the paper tape, received via TTY, to 1-inch mylar tape. The errata may either be spliced onto the end of the basic program tape or loaded with the basic program and a new program tape punched containing the errata.

d. TTY for MSFTP-3. Errata for this decom will be received via HSD transmission or TTY message. The errata will be in 5-level, 8-level format, or manual. Errata will be verified upon receipt and acknowledged. The errata will be spliced to the end of the basic program or (at station option) it may be incorporated into the program by use of the 642B SCAN Control No. 6-348. Subsequent to dumping the core, the output must be checked for proper operation.

e. Mail/High-speed. Splice all 1-inch, 5- or 8-level errata tapes r-ceived by mail or HSD onto the end of the basic program tape after they have been verified.

6.6.2.10 Program Tape Interpretation. To assis personnel interpreting the data containedon the program tapes for the present decoms and simulators, figures 6-4 through 5-9 are provided as aids for interpretation.

a. The MSFTP-2 simulator 8-level format is shown in figure 6-4.

b. The MSFTP-2 simulator 5-level format is shown in figure 6-5.

c. The MSFTP-2 decommutator 8-level format is shown in figure 6-6.

d. The MSFTP-2 decommutator 5-level format is shown in figure 6-7.

e. The MSFTP-3 decommutator format is shown in figure 6-8. Track 6 is punched to indicate 8-level and enable the parity bit in track 8. When track 6 is not punched, only tracks 1 through 5 are read and the character parity checker is disabled.

f. The PCM/DHS simulator/decommutator format is shown in figure 6-9. Eight-level program tapes are not currently being issued by Code 852.2 The simulator or decommutator unit select character need only appear once at the beginning of the program tape.

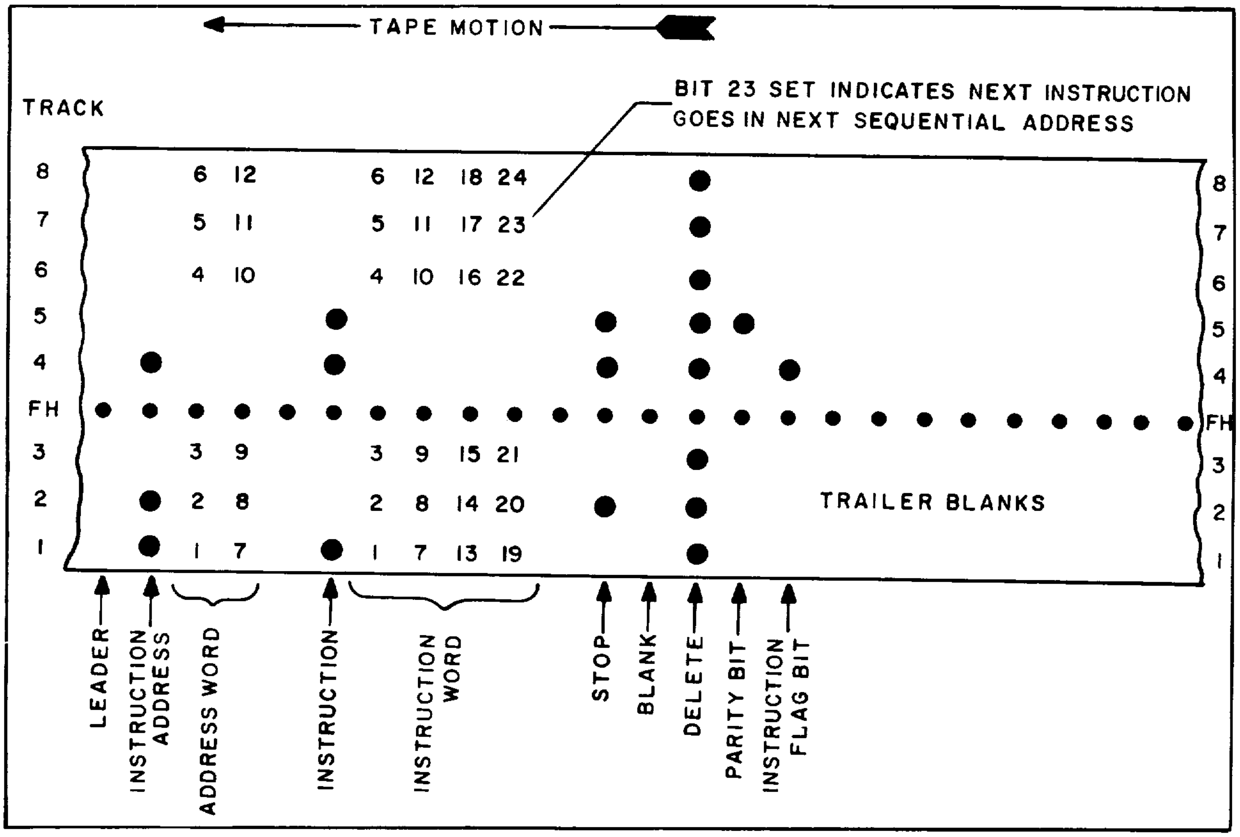


Figure 6-4. MSFTP-2 Simulator Tape 8-level Format

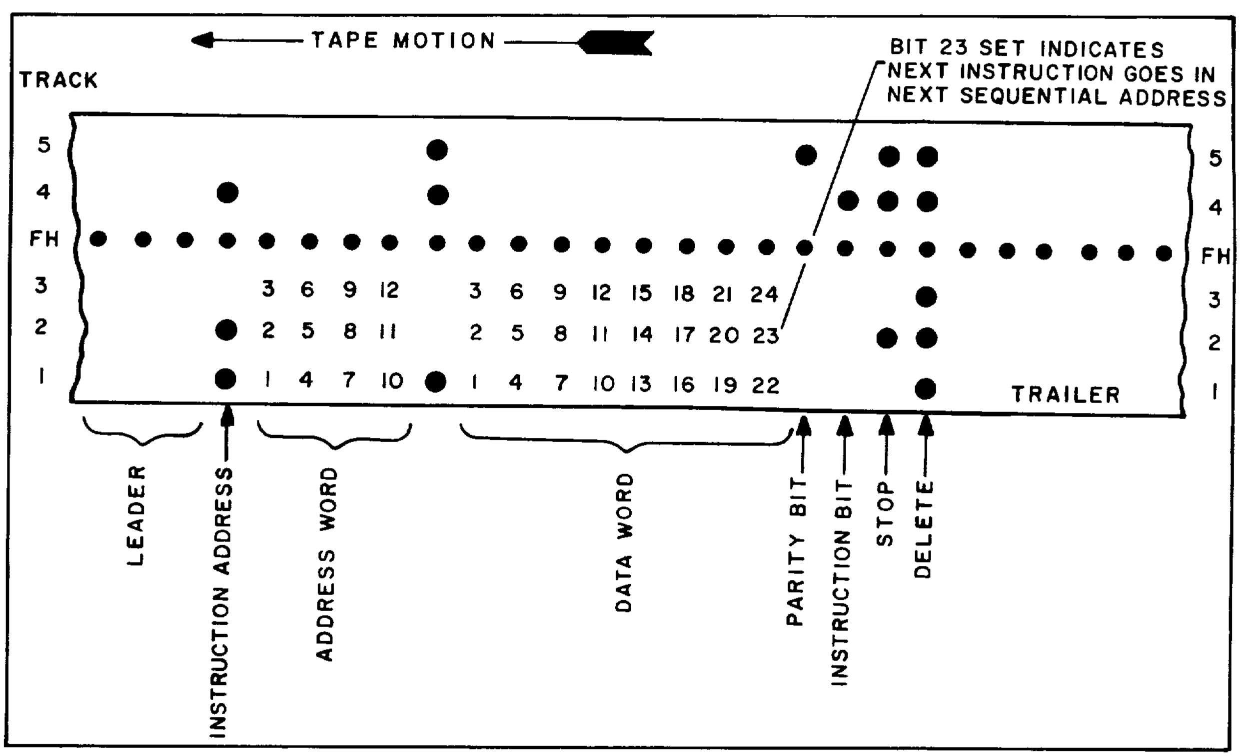


Figure 6-5. MSFTP-2 Simulator Tape 5-level Format

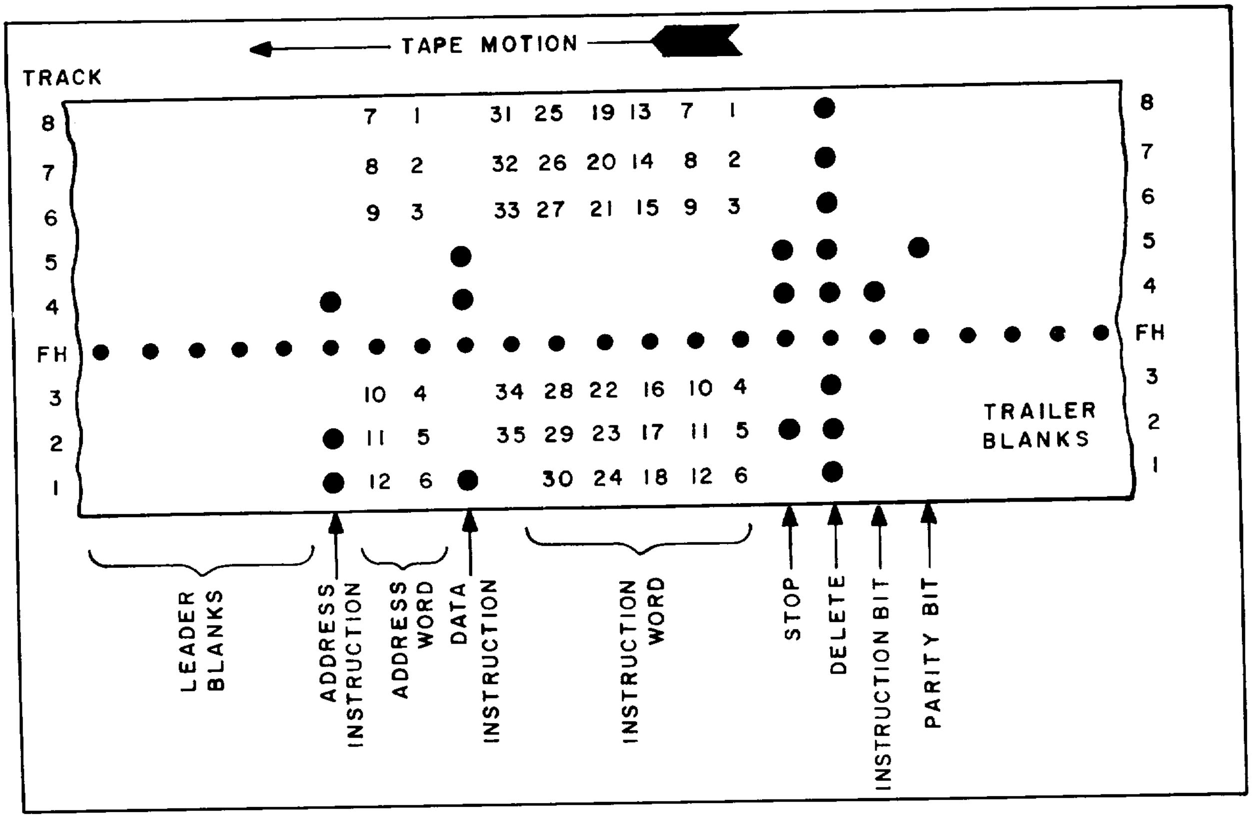


Figure 6-6. MSFTP-2 Decom Tape 8-level Format

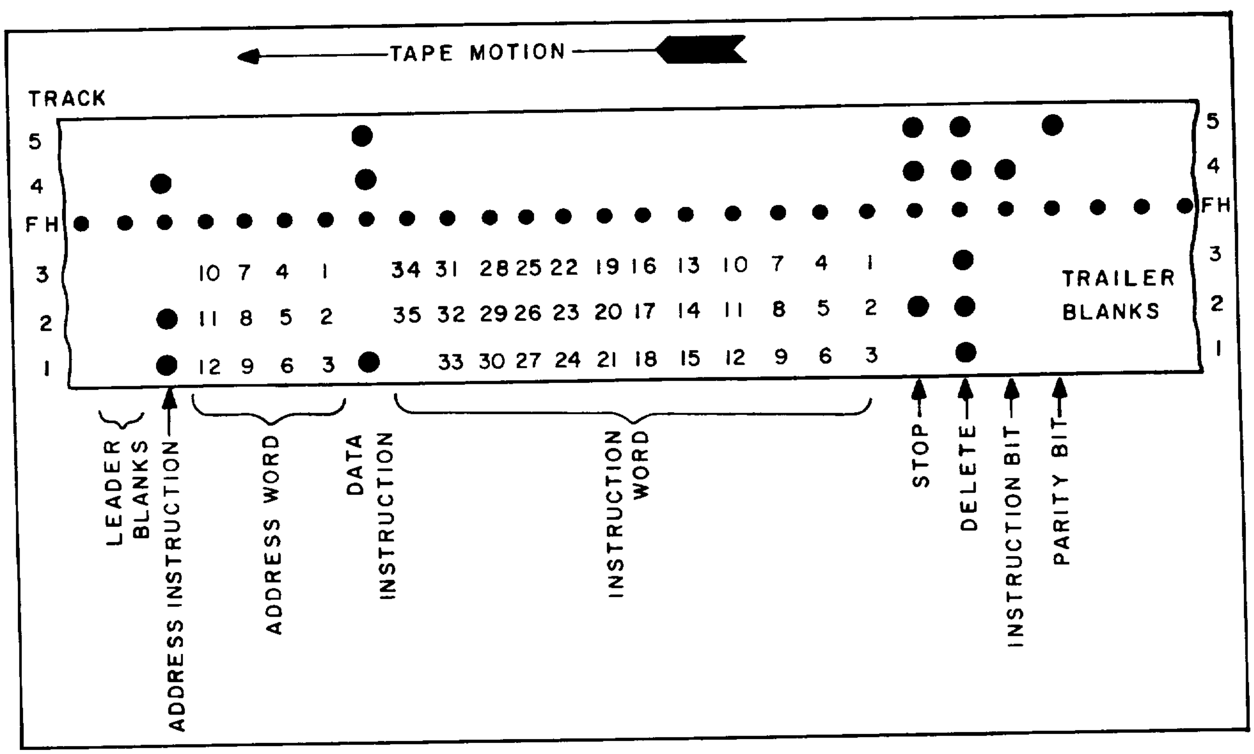
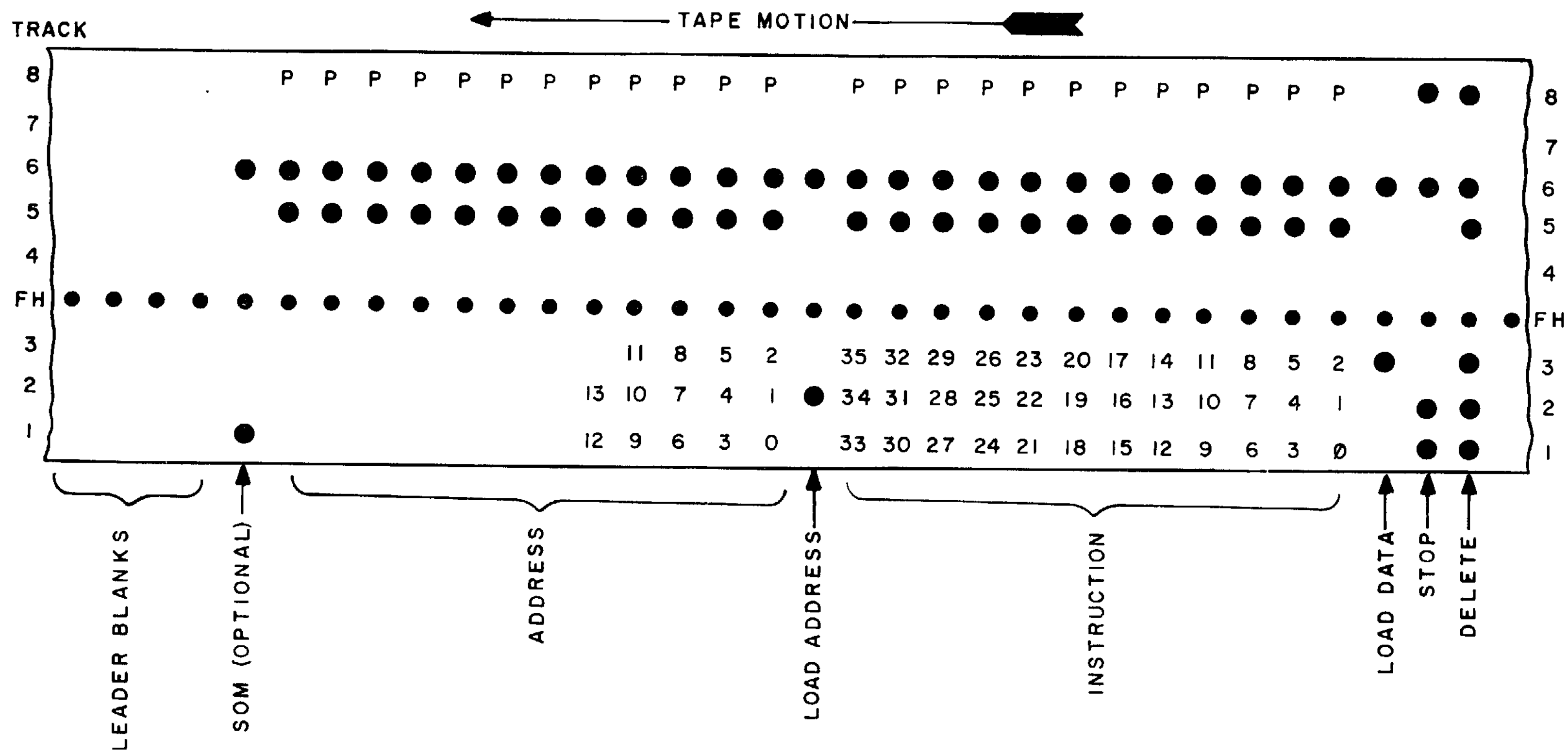


Figure 6-7. MSFTP-2 Decom Tape 5-level Format



1. P = PARITY BIT FOR 8 LEVEL
2. TRACK 6 - PUNCHED = 8 LEVEL TAPE / NOT PUNCHED = 5 LEVEL TAPE
3. TRACK 7 - NEVER PUNCHED
4. TRACK 4 - PUNCHED & FEED HOLE = DELETE
5. SOM IS AN OPTIONAL CHARACTER AND MAY OR MAY NOT BE PRESENT
6. TRACK 5 - PUNCHED = DATA / NOT PUNCHED = CONTROL
7. THERE MUST ALWAYS BE 12 DATA CHARACTERS BETWEEN CONTROL CHARACTERS (EXCLUDING "STOP" AND "DELETE")

Figure 6-8. MSFTP-3 Decom Tape 5- or 8-level Format

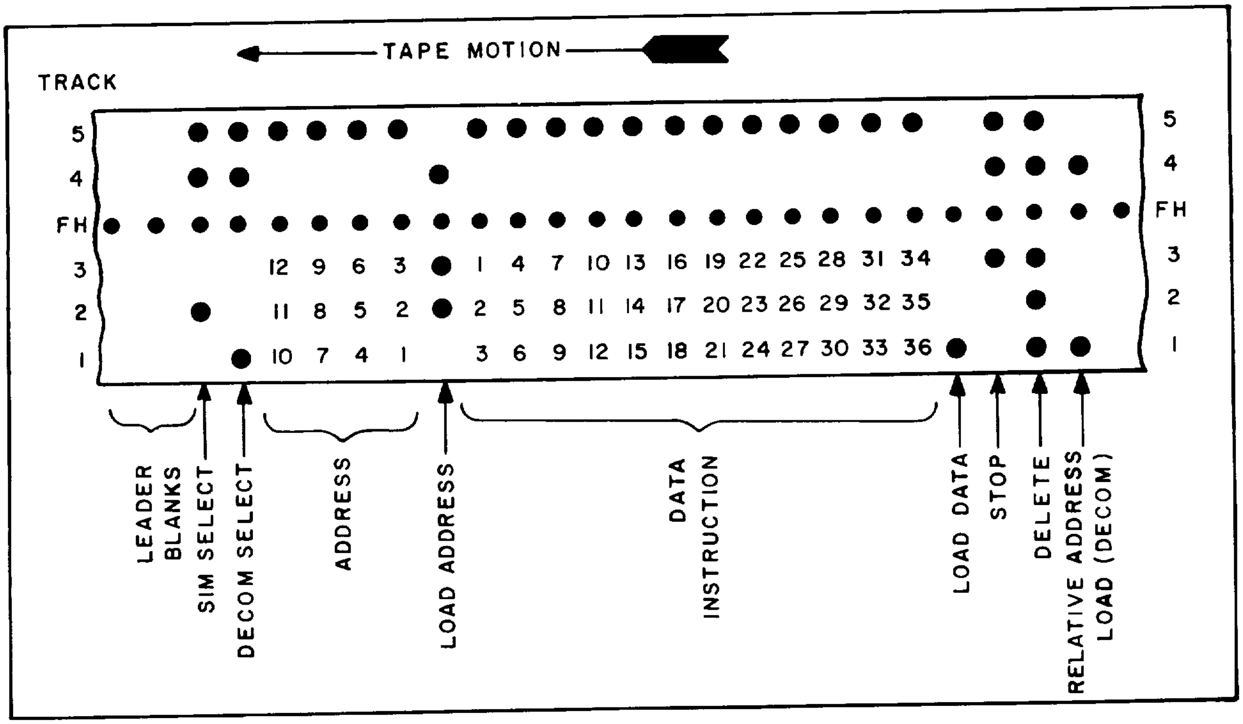


Figure 6-9. PCM/DHS Decom/Sim Tape 5-level Format

SECTION 7. SPECIAL SUPPORT ACTIVITIES

SECTION 7. SPECIAL SUPPORT ACTIVITIES

7.1 GENERAL

Information presented in this section is provided as supplementary information. Procedures and equipment nomenclatures are not applicable to all stations.

7.2 SPACECRAFT FREQUENCY MEASUREMENT

7.2.1 GENERAL

7.2.1.1 Spacecraft downlink frequency measurements are often required to determine if frequency drift has occurred after launch.

7.2.1.2 Two acceptable methods of verification are discussed in this document. Method 1 pertains to the usage of special equipment such as Hewlett Packard 5245L Frequency Counter, and the 562A Hewlett Packard Line Printer (not available at all stations). Method 2 utilizes the STDN Ranging System.

7.2.1.3 Methods 1 and 2 provide a means of determining spacecraft point of closest approach (PCA). (At PCA, Doppler effects are minimal and a representative frequency may be determined.)

7.2.2 METHOD NUMBER 1

7.2.2.1 Set up system receiver to the frequency of the downlink to be measured. (Refer to applicable NOSP for link description.)

7.2.2.2 Connect station time standard frequency reference to Ext. Std. Freq. jack of the HP-5245L counter. (L models require 1 MHz; M models require 10 MHz.)

7.2.2.3 Connect the HP-562A digital printer to the output of the HP 5245L counter.

7.2.2.4 Connect the input of the HP-5245L counter to the wideband VCO output (DTR receivers with Electrac demods) or to the VCO output (for MFR receiver) being used for pass support.

7.2.2.5 Using a Hewlett-Packard 8660C signal generator, set the output frequency to the rate determined in para 7.2.2.1 and patch signal to RF preamp of antenna system utilized for support, -110 dBm level.

7.2.2.6 Record frequency of signal generator found in para 7.2.2.1; label this frequency F-1.

7.2.2.7 After achieving VCO lock on the applicable receiver, record VCO frequency with signal generator as input source. Label this frequency F-2.

7.2.2.8 Disconnect signal generator from antenna system and prepare for pass with HP-5245L and 562A printer still connected to applicable receiver.

7.2.2.9 Select 5-second interval printout on 562A digital printer. At PCA-1 minute (as determined from IRV message) turn 562A digital printer on for 2 minutes from PCA -1 minute to PCA +1 minute.

7.2.2.10 After LOS, determine from Doppler printout of VCO frequency where PCA occurred. Note VCO frequency and label this F-3 (max frequency shift of VCO from line to line on 1 per 5-second printout).

7.2.2.11 Utilizing the following formula determine spacecraft downlink frequency:

F1 + F2 = ______________
- F3 = ______________ Spacecraft frequency

Example:

F1 (freq of signal generator)		136.20 MHz	
F2 (freq of Rx VCO w/signal gen input)		.400000	(as read from digital
	F1 + F2	136.600000	counter/printer)
F3 (Rx VCO freq at PCA)	- F3	.399673	
	Spacecraft freq =	136.200327 MHz	

7.2.2.12 An example of a printout for spacecraft frequency measurement follows:

Line	Tens of Min	Units of Min	Tens of Sec	Units of Sec	Hertz 10^5	Hertz 10^4	Hertz 10^3	Hertz 10^2	Hertz 10^1	Hertz 10^0	Difference
10	3	5	2	5	3	9	9	4	4	4	64
9	3	5	2	0	3	9	9	3	8	0	66
8	3	5	1	5	3	9	9	3	1	4	67
7	3	5	1	0	3	9	9	2	4	7	69
6	3	5	0	5	3	9	9	1	7	8	71*
5	3	5	0	0	3	9	9	1	0	7	70*
4	3	4	5	5	3	9	9	0	3	7	69
3	3	4	5	0	3	9	8	9	6	8	68
2	3	4	4	5	3	9	8	9	0	0	67
1	3	4	4	0	3	9	8	8	3	3	

*PCA is indicated because line 5/6 difference is at greatest point.

7.2.3 METHOD NUMBER 2

7.2.3.1 General. Method 2 uses the Doppler display of the STDN Ranging Equipment (SRE) on the coherent link to determine the PCA. A frequency counter is configured to measure the MFR VCO output from the noncoherent link.

7.2.3.2 Procedures. Procedures are as follows:

a. Connect the VCO output of the selected MFR to the input of an HP-5245L frequency counter. A compatible digital printer may be interfaced to the HP-5245L for recording purposes.

b. Adjust the counter sensitivity to obtain a consistent count prior to expected PCA.

c. When the SRE Doppler display indicates all 0's, record GMT and set counter sample display knob to HOLD.

d. The MFR VCO frequency is displayed showing VCO frequency at PCA.

e. Using the following method, calculate SC frequency:

F1 VCO center freq = 400000 Hz.

F2 freq of VCO at PCA = 410555 Hz.

F3 digiswitch setting MFR = 134.40 MHz.

Freq of VCO at PCA = F2 =	410555 Hz
VCO center freq = F1 =	400000 Hz
Difference =	10555 Hz
Receiver setting F3	134.400000 Hz
	+ 10555 Hz
	134.410555 Hz

Note

If a coherent signal/link is not available to determine PCA, the operator uses the available information (angle updates, predicts, auto track angles) to determine the time of PCA.

7.3 SPACECRAFT SPIN/TUMBLE MEASUREMENT PROCEDURE

7.3.1 GENERAL

Due to spacecraft anomalies, occasions may arise when it is desirable to know the spin or tumble rate of the spacecraft. These rates may be established with a reasonable degree of accuracy by analysis of AGC stripchart recordings or, in some cases, interpretation of AGC meter readings. Extremely rapid spin or tumble rates may be impossible to measure due to limits imposed by the receiver AGC recovery time.

7.3.2 CHARACTERISTICS

7.3.2.1 A definite indication of spacecraft spin or tumble is indicated by a lobing effect on the AGC bus caused by spacecraft antenna orientation in relation to the ground receiving station. Spin-stabilized spacecraft have an antenna configuration which provides a constant amplitude signal at ground receiving stations and is not applicable to this procedure.

7.3.2.2 The receiver AGC voltage variation (caused when the spacecraft antenna is oriented away from the receiving station) varies directly proportional to the spin or tumble rate, limited only be receiver AGC voltage recovery time.

7.3.3 MEASUREMENT

7.3.3.1 Two methods are available for determining spin or tumble rate using the AGC stripchart in relation to time. Either method may be used to determine spin or tumble rate:

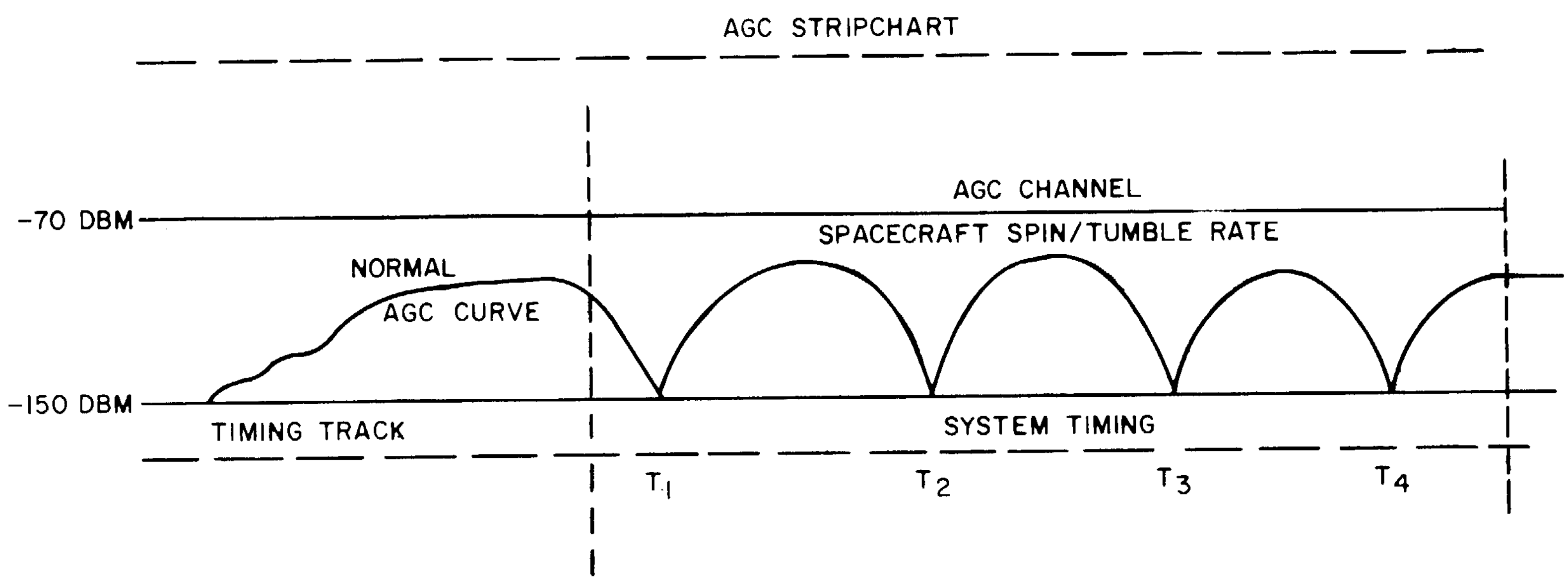
a. Count the millimeters between each AGC null point, reference this to the recorder speed (x millimeters per second), and use the following formula:

$$\frac{\text{Recorder Speed}}{\text{Millimeters Between Null Points}} \times 60 = \text{rev/min}$$

b. Use the timing signal on the AGC stripchart, read the elapsed time from null point to null point, and use the following formula:

$$\text{Frequency in rev/min} = \frac{60}{\text{Time (Time from T1 to T2)}}$$

7.3.3.2 See figure 7-1 for an example of measuring techniques.



Alternate Method

Freq = (rev/min) $\frac{60}{\text{Time}}$ from T_1 to T_2
(As read from Timing Signal)

Example: Time from T_1 to T_2 = 1 sec

Freq = $\frac{60}{1}$ = 60 rev/min

Recorder Chart speed = 10/mm sec

Number of millimeters between T_1 and T_2 = 10

To find Spin/Tumble rate

$$\frac{\text{Recorder Speed mm/sec}}{\text{Number of millimeters between null points}} \times 60 = \text{Spin/Tumble Rate (rev/min)}$$

Example: $\frac{\text{Recorder Speed} = 10\text{ mm/sec}}{\text{Number of millimeters from } T_1 \text{ to } T_2 = 10\text{ mm}}$ = 1x60=60 rev/min

Figure 7-1. Spacecraft Spin/Tumble Measurements

7.4 SYSTEM TIME DELAY MEASUREMENTS

7.4.1 GENERAL

Time delay measurements are required at selected STDN stations that are requested to time tag telemetry data within the 100 μsec requirement. Time delay measurements are taken prepass and postpass. This measurement is given in microseconds (average 10 readings) and reported in PASSUM under REMARKS. Station equipment configurations are similar to Bit Error Rate (BER) configurations, except the MSFTP-3 decom and serial output is used instead of a PCM simulator.

7.4.2 PROCEDURE

7.4.2.1 Prior to AOS (prepass checks) and/or after LOS plus 2 minutes, configure the telemetry system according to figure 7-21.

7.4.2.2 Using the MSFTP-3 decom time delay loop test format described in the applicable SSI, use the data from the serial output buffer to modulate the test transmitter. Set the frequency synthesizer as specified in applicable NOSP.

7.4.2.3 The test signal flow path should be identical to the spacecraft signal path. The receiver settings and patching should not be changed.

7.4.2.4 After the decom indicates PCM lock, the system time delay is continuously displayed on the display unit in microseconds.

7.4.2.5 The MSFTP-3 time delay format should be reset before beginning the RF loop tests to ensure erroneous time delay measurements are not loaded.

7.4.3 TIME CORRELATION OPERATIONS

7.4.3.1 Stations scheduled for time correlation operations proceed as follows:

a. Configure the MSFTP-3/642B for the time correlation operation and another decom/642B for normal real-time support.

b. Perform the system time delay check prepass before supporting the time correlation operation.

c. Select the correct format for the time correlation operation.

d. Set the computer buffer inhibit ON/OFF switch to OFF for the computer buffer in use.

e. Set the computer buffer inhibit switch ON after completing the time correlation operation.

f. Perform the time delay measurement postpass and report the results on the PASSUM.

7.4.3.2 If a problem is encountered during real-time building of the time correlation store/forward digital tape, the time correlation is lost. A rebuild from the analog tape is invalid.

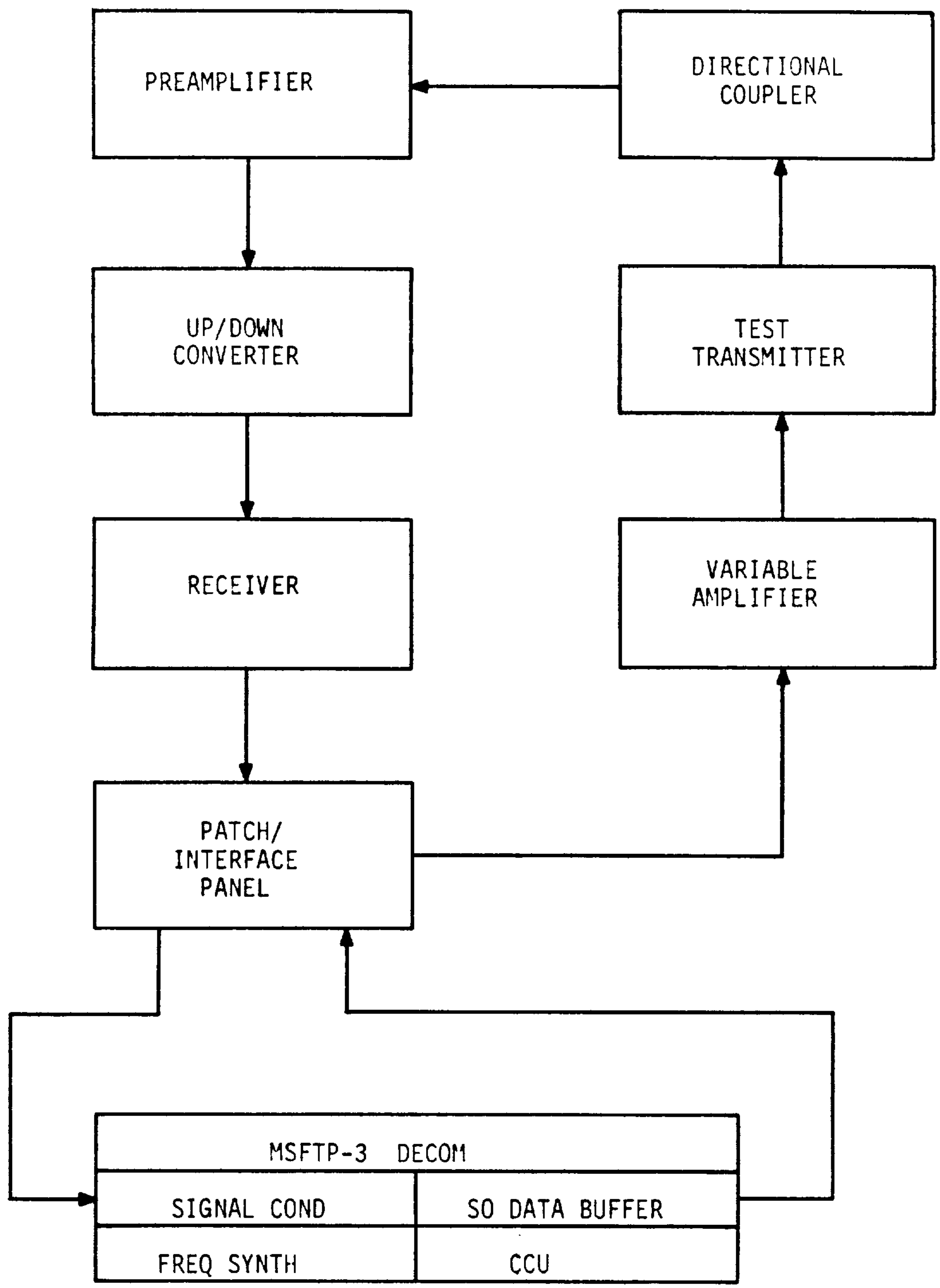


Figure 7-2. Typical Station Configuration for Time Delay Tests

7.5 MODULATION DEPTH MEASUREMENT

7.5.1 GENERAL

It is occasionally necessary to measure modulation depth of various signals. In general, STDN personnel are concerned with Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM).

7.5.2 AMPLITUDE MODULATION

Characteristics of amplitude modulation are described in appendix C. Measurement of modulation depth or percent of modulation is normally accomplished by use of an oscilloscope. The following two methods are provided:

7.5.2.1 Method 1

a. The AM signal to be measured is applied to the vertical input of the oscilloscope and the horizontal sweep rate of the scope is adjusted to provide a display of the carrier envelope as shown in figure 7-3(A). As shown in this figure, E1 and E2 are the maximum and minimum amplitudes of the modulation envelope. The modulation envelope shown represents the modulation frequency, while the higher frequency shown within the envelope represents the carrier frequency being modulated. As modulation depth (or level) is increased, the value of E2 will approach zero while the value of E1 will increase correspondingly.

b. By definition, modulation depths vary from 100 to 0 percent. A 100-percent modulation depth is represented by the level at which E2 reaches a value of 0, while 0-percent represents the unmodulated state in which E1 and E2 are equal. Values between 0 and 100 percent may be calculated roughly by comparing the E2 versus E1 ratios as presented in table 7-1. More accurate measurements may be made by using the formula presented in figure 7-3(A).

Table 7-1. AM Modulation Carrier Drop and Envelope Height Ratio

Modulation Percentage	Envelope or Trapezoid Display Max Height to Min Height Ratio	Carrier Power Decrease (dB)
0	1:1	0
10	1.22:1	0.23
20	1.5:1	0.46
30	1.86:1	0.71
40	2.33:1	0.97
50	3.0:1	1.25

Table 7-1. AM Modulation Carrier Drop and Envelope Height Ratio (cont)

Modulation Percentage	Envelope or Trapezoid Display Max Height to Min Height Ratio	Carrier Power Decrease (dB)
60	4.0:1	1.55
70	5.68:1	1.87
80	9.0:1	2.2
90	19:1	2.6
100	-----	3

7.5.2.2 Method 2

a. This method of measurement applies primarily to transmitters. Connect the equipment as follows:

(1) Connect modulating signal to the external horizontal input of the oscilloscope. With the modulation signal present, adjust the horizontal sweep for approximately 3/4 of maximum sweep across the oscilloscope viewing face.

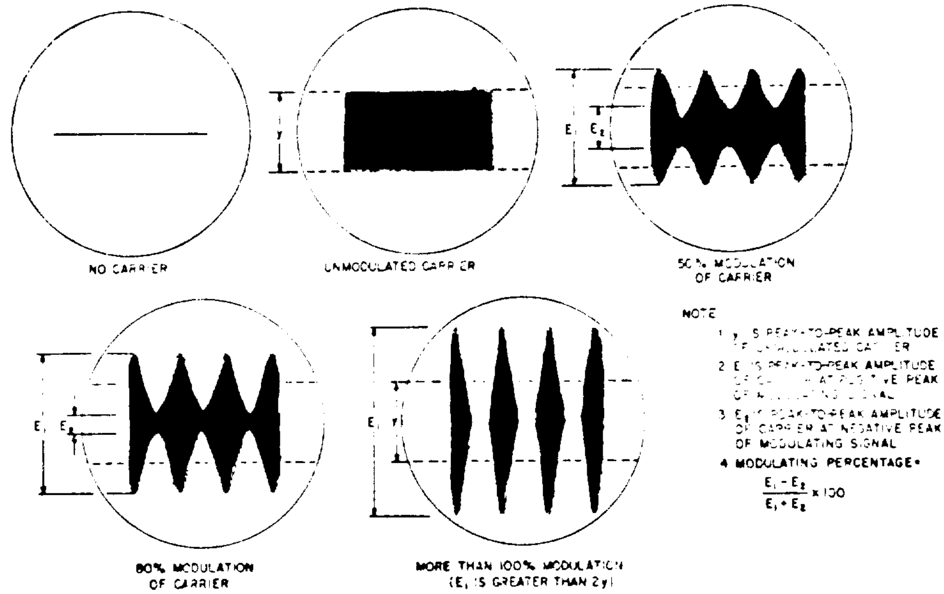
(2) Apply the transmitted carrier (in most cases taken from the IF of a receiver) to the vertical input of the oscilloscope.

b. The resultant pattern is a trapezoidal shape as shown in figure 7-3(B). Depending upon phase characteristics of the receiver and other factors, some distortion may be present, but the basic pattern will exist. Modulation level may be calculated from the formula accompanying figure 7-3(B). Approximate modulation percentage may be easily estimated by reference to E1 and E2 ratios and interpolating by reference to table 7-1.

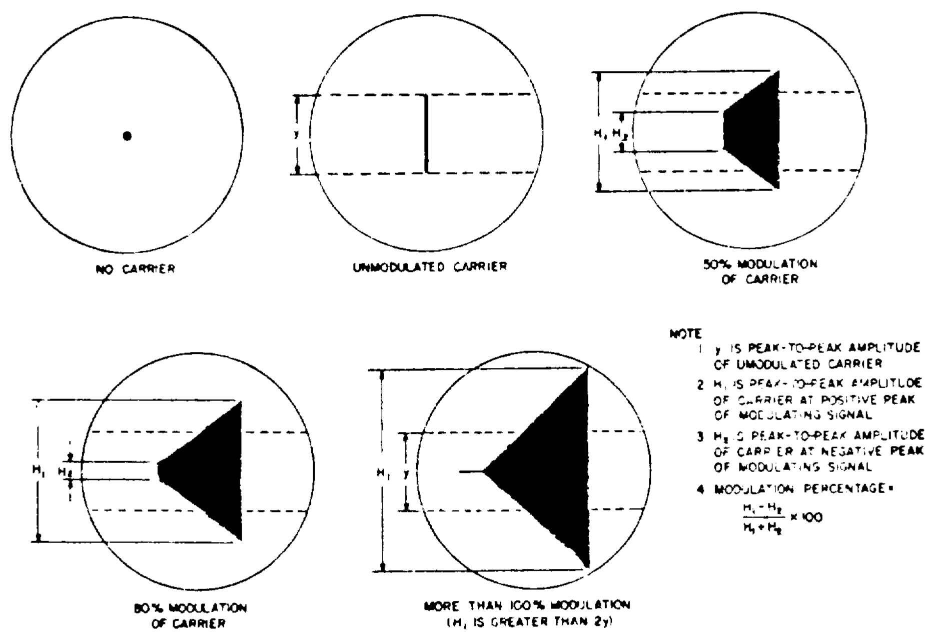
c. Table 7-1 also includes a column labeled "Carrier Power Decrease (dB)" in which values are listed in decibels, which is useful for estimating modulation percentage. The 0-dB level drop represents an unmodulated carrier. As modulation level is increased the carrier level decreases. Monitoring of the level is best done on a calibrated spectrum analyzer, though on some equipment is is possible to use signal level meters.

7.5.3 FREQUENCY MODULATION

7.5.3.1 General. Frequency modulation characteristics are briefly described in appendix C; however, a more complete description of FM characteristics is appropriate for discussion of modulation index and measurement.



A. MODULATION WAVE ENVELOPE



B. TRAPEZOIDAL PATTERN

Figure 7-3. Determination of Modulation Percentage

7.5.3.2 Characteristics. A fundamental characteristic of FM is that the frequency deviation is proportional to the peak amplitude of the applied modulation and independent of the modulation frequency. At the same time, the dispersion of modulation products within the frequency deviation spectrum is a function of the modulating frequencies. By definition, the modulation index of a frequency modulated wave is a function of a combination of these factors, as follows:

$$\text{Modulation Index} = \frac{\text{Frequency Deviation}}{\text{Modulating Frequency}} \quad \text{or:} \quad MI = \frac{\Delta f}{F}$$

Note that the modulation index is directly proportional to frequency deviation, and inversely proportional to the modulating frequency.

7.5.3.3 Measurement. Considering the facilities normally available within the STDN, the most practical approach to FM modulation index measurement is through use of a spectrum analyzer. The following procedure is suggested:

a. Adjust the signal display to center the signal spectrum, ensuring that all significant sidebands are shown within the edges of the display and that vertical amplitude of the display is as high as practical. Note the height and horizontal baseline position of the carrier and all significant sidebands within the signal passband, and record the approximate RF signal level in -dBm.

Note

1. Adjusting the spectrum analyzer will require care and discretion on the part of the operator. Considering the widely varying nature of FM signals encountered in the STDN, no firm guidelines can be given. Practice in studying representative signals is suggested, using appropriate NOSP's.

2. After these steps are complete, do not change any of the analyzer control settings.

b. Upon completion of a pass, connect an FM signal generator to the receiver, preamp, or boresight input as appropriate. While applying modulation to the generator, vary the level and frequency and monitor the spectrum analyzer display. Signal level into the receive system should match that of the original signal. Duplicate, insofar as possible, the appearance of the original signal on the analyzer. In many cases, complexity of the original spacecraft modulation will necessitate settling for an approximation of the original signal's spectrum; in others the spectrum should be quite similar. (Refer to applicable NOSP's for additional information if required.)

c. After the preceding conditions have been met, the modulation index may be calculated by noting the deviation (taken from the signal generator modulation meter or interpolated from the spectrum display) and the modulation frequency, using the formula in para 7.5.3.2.

7.5.4 PHASE MODULATION

7.5.4.1 General. General characteristics of phase modulation are discussed briefly in appendix C; however, elaboration of pertinent details is appropriate before discussing modulation index measurement.

7.5.4.2 Characteristics

a. Phase modulation is a system in which the frequency deviation is proportional to the amplitude and frequency of the modulating signal. By contrast, deviation of a frequency modulated carrier is independent of modulation signal frequency. Phase modulation, therefore, is a method of generating a frequency modulated wave in which the frequency deviation is proportional to the modulating frequency.

b. A phase modulated wave is a sine wave in which the phase is shifted in proportion to the instantaneous amplitude of a modulating signal, as referenced to its basic frequency (or phase shift of zero degree or radians).

7.5.4.3 Measurement

a. The modulation index is normally measured in radians (where one radian equals 57.3 degrees of phase shift) and is proportional to the amplitude of the modulating signal but independent of the modulating frequency.

b. A practical method of measuring phase modulation index using phase-lock demods is as follows:

(1) Pick a time period during the pass at which the spacecraft AGC is at maximum; i.e., at about PCA. RFI and propagation disturbance should be at minimum. Select the receiver showing best AGC.

(2) During the measurement period defined in step (1), record the AGC voltage developed at the receiver output, and the AGC voltage developed at the demodulator. Ideally, a digital voltmeter should be used.

(3) Postpass, insert a CW signal into the RF system input, adjusting the level to equal the level recorded at the receiver output during the pass. Mark the signal generator attenuator setting. Record AGC level at demod output.

(4) Switch receiver AGC to manual. Adjust manual gain to bring demod AGC level to the same as recorded in step (3).

(5) Adjust signal generator output to bring demod AGC level to that recorded in step (2). Mark the attenuator setting.

(6) Compare the two indications at the signal generator attenuator in terms of decibels.

(7) From tables 7-2 and 7-3, interpolate the amount of carrier drop in terms of decibels versus modulation index.

Note

> The basic point of interest is the amount of carrier drop between a modulated an an unmodulated carrier. This carrier drop is directly related to the modulation index; i.e., the amount of power diverted from the center carrier into the sidebands. The effect can also be measured with a spectrum analyzer and, with experience, will be a handy ready reference for estimating PM modulation index.

7.5.4.4 Supplementary Phase Modulation Information

a. General. Paragraphs 7.5.4.4b through e are provided to acquaint the receiver operators with the procedure for calculating modulation in radians when carrier suppression is given, and the carrier suppression when modulation is given. The derivation of each is based on Bessel functions. It is necessary to know how to handle the mathematical analysis of a Bessel function to perform these calculations, but it is necessary to know how to read the Bessel function curve shown in figure 7-4.

b. Bessel Function Curve Method of Calculation. The curves $J_0(x)$, $J_1(x)$, $J_2(x)$, and $J_3(x)$ in figure 7-4 represent the carrier and first, second, and third sidebands. Note that where the $J_0(x)$ curve intersects the $J_1(x)$ curve the abscissa is 1.44. The abscissa of this curve is in radians, therefore $J_0(x)$ equal $J_1(x)$ and is 1.44 radians of modulation, and the carrier is equal to the first sideband. Also note that the ordinate where $J_0(x)$ equals $J_1(x)$ is approximately 0.55 value of the function (right-hand scale) and approximately 5.2 dB (left-hand scale).

c. Finding Carrier Suppression. The following example will demonstrate how to use the Bessel function curve to find the carrier suppression in decibels of 1.44 radians of modulation:

Example:

$$dB = 20 \log \frac{E_1}{E_2}$$

where: dB = Carrier suppression in decibels.

E_1 = Unmodulated carrier voltage equals 1.

E_2 = Carrier relative (peak) amplitude voltage equals 0.55.

Substituting the value of E_1 and E_2 then:

$$dB = 20 \log \frac{1}{0.55}$$

$$= 20 \log 1.82$$

$$= 20\ (0.260) \text{ equals } 5.2.$$

Table 7-2. Carrier Supression and Modulation Loss for Square Wave Modulation

CARRIER SUPPRESSION			MODULATION LOSS IN DB	DEGREES OF PHASE SHIFT
RADIANS	RELATIVE	DB		
0.02	.9998	0.00	34.00	1.15
0.04	.9992	0.01	28.00	2.29
0.06	.9982	0.02	24.45	3.44
0.08	.9968	0.03	21.95	4.58
0.10	.995	0.04	20.00	5.73
0.12	.9928	0.07	18.43	6.88
0.14	.9902	0.09	17.09	8.03
0.16	.9872	0.12	15.96	9.16
0.18	.9838	0.15	14.96	10.30
0.20	.9801	0.18	14.05	11.45
0.22	.9759	0.22	13.22	12.60
0.24	.9713	0.26	12.48	13.75
0.26	.9664	0.30	11.80	14.90
0.28	.9611	0.35	11.18	16.04
0.30	.9553	0.40	10.59	17.19
0.32	.9492	0.45	10.05	18.34
0.34	.9428	0.52	9.53	19.19
0.36	.9359	0.58	9.08	20.61
0.38	.9287	0.64	8.62	21.78
0.40	.9211	0.71	8.20	22.90
0.42	.9131	0.80	7.78	24.10
0.44	.9048	0.88	7.40	25.24
0.46	.8961	0.96	7.06	26.36
0.48	.8870	1.05	6.72	27.50
0.50	.8776	1.14	6.38	28.68
0.52	.8678	1.24	6.08	29:80
0.54	.8577	1.34	5.78	30.95
0.56	.8473	1.44	5.51	32.06
0.58	.8365	1.55	5.23	33.20
0.60	.8253	1.67	4.97	34.36
0.62	.8139	1.79	4.73	35.50
0.64	.8021	1.92	4.48	36.65
0.66	.790	2.06	4.26	37.85
0.68	.7776	2.19	4.04	38.95
0.70	.7648	2.32	3.84	40.20
0.72	.7518	2.49	3.62	41.30
0.74	.7385	2.64	3.42	42.40
0.76	.7248	2.79	3.26	43.50
0.78	.7109	2.98	3.08	44.60
0.80	.6967	3.14	2.90	45.80
0.82	.6822	3.33	2.73	47.00
0.84	.6675	3.52	2.57	48.15
0.86	.6524	3.72	2.42	49.30
0.88	.6372	3.92	2.27	50.40
0.90	.6216	4.14	2.14	51.60
0.92	.6056	4.34	2.00	52.65
0.94	.5898	4.58	1.86	53.80
0.96	.5735	4.84	1.74	55.00
0.98	.5570	5.11	1.61	56.20
1.00	.5403	5.35	1.50	57.30
1.02	.5234	5.64	1.39	58.50
1.04	.5062	5.92	1.29	59.60
1.06	.4889	6.22	1.19	60.75
1.08	.4713	6.54	1.09	61.90
1.10	.4536	6.89	1.00	63.10
1.12	.4357	7.23	0.91	64.20
1.14	.4176	7.62	0.83	65.40
1.16	.3993	7.99	0.75	66.50
1.18	.3809	8.38	0.68	67.60
1.20	.3624	8.86	0.61	68.80
1.22	.3437	9.32	0.54	70.00
1.24	.3248	9.79	0.48	71.10
1.26	.3058	10.32	0.43	72.25
1.28	.2867	10.88	0.37	73.40
1.30	.2675	11.49	0.32	74.55
1.32	.2482	12.12	0.28	75.65
1.34	.2288	12.83	0.23	76.80
1.36	.2092	13.66	0.19	78.00
1.38	.1896	14.55	0.16	79.20
1.40	.170	15.48	0.13	80.30
1.42	.1502	16.52	0.10	81.40
1.44	.1304	17.70	0.08	82.50
1.46	.1106	19.13	0.06	83.65
1.48	.0907	20.86	0.04	84.80
1.50	.0707	23.13	0.03	86.00
1.52	.0508	26.08	0.02	87.15
1.54	.0308	30.66	0.01	88.30
1.56	.0108	39.58	0.00	89.40
1.57	.0008		0.00	90.00

Table 7-3. Carrier Supression and Modulation Loss for Sine Wave Modulation

CARRIER SUPPRESSION			MODULATION LOSS	
RADIANS	RELATIVE	DB	RELATIVE	DB
0.00	1.00	0.00	.0000	∞
0.05	.9994	0.01	.0250	32.0
0.10	.9975	0.02	.0499	26.2
0.15	.9944	0.05	.0748	22.4
0.20	.9900	0.09	.0995	20.0
0.25	.9844	0.14	.1240	18.13
0.30	.9776	0.20	.1483	16.58
0.35	.9696	0.27	.1723	15.28
0.40	.9604	0.35	.1960	14.15
0.45	.9500	0.45	.2194	13.18
0.50	.9385	0.55	.2423	12.31
0.55	.9267	0.67	.2647	11.55
0.60	.9120	0.80	.2867	10.85
0.65	.8971	0.94	.3081	10.23
0.70	.8312	1.10	.3290	9.66
0.75	.8642	1.27	.3492	9.14
0.80	.8463	1.45	.3688	8.66
0.85	.8274	1.65	.3878	8.23
0.90	.8075	1.86	.4059	7.83
0.95	.7868	2.10	.4234	7.47
1.00	.7652	2.32	.4401	7.13
1.05	.7428	2.58	.4559	6.82
1.10	.7196	2.86	.4709	6.54
1.15	.6957	3.15	.4850	6.29
1.20	.6711	3.46	.4983	6.08
1.25	.6459	3.80	.5106	5.84
1.30	.6201	4.15	.5220	5.65
1.35	.5937	4.53	.5325	5.47
1.40	.5669	4.93	.5419	5.32
1.45	.5395	5.36	.5504	5.19
1.50	.5118	5.82	.5579	5.07
1.55	.4838	6.31	.5644	4.97
1.60	.4554	6.83	.5699	4.88
1.65	.4268	7.40	.5743	4.82
1.70	.3980	8.00	.5778	4.76
1.75	.3690	8.66	.5802	4.73
1.80	.3400	9.37	.5815	4.71
1.85	.3109	10.15	.5818	4.71
1.90	.2818	11.00	.5812	4.71
1.95	.2528	11.95	.5794	4.74
2.00	.2239	13.00	.5767	4.78
2.05	.1951	14.20	.5730	4.84
2.10	.1666	15.56	.5683	4.91
2.15	.1383	17.18	.5626	5.00
2.20	.1104	19.14	.5560	5.10
2.25	.0828	21.66	.5484	5.22
2.30	.0555	25.12	.5399	5.35
2.35	.0288	30.80	.5305	5.51
2.40	.0025	52.0	.5202	5.68
2.45	-.0232	32.68	.5091	5.86
2.50	-.0484	26.30	.4971	6.07
2.55	-.0729	22.74	.4843	6.30
2.60	-.0968	20.28	.4708	6.54
2.65	-.1200	18.42	.4566	6.81
2.70	-.1424	16.93	.4416	7.10
2.75	-.1641	15.70	.4260	7.41
2.80	-.1850	14.66	.4097	7.75
2.85	-.2051	13.76	.3928	8.12
2.90	-.2243	12.99	.3754	8.51
2.95	-.2426	12.30	.3575	8.93
3.00	-.2601	11.70	.3391	9.39
X	Jo(x)	20 log Jo(x)	J1(x)	20 log J1(x)
BESSEL FUNCTIONS				

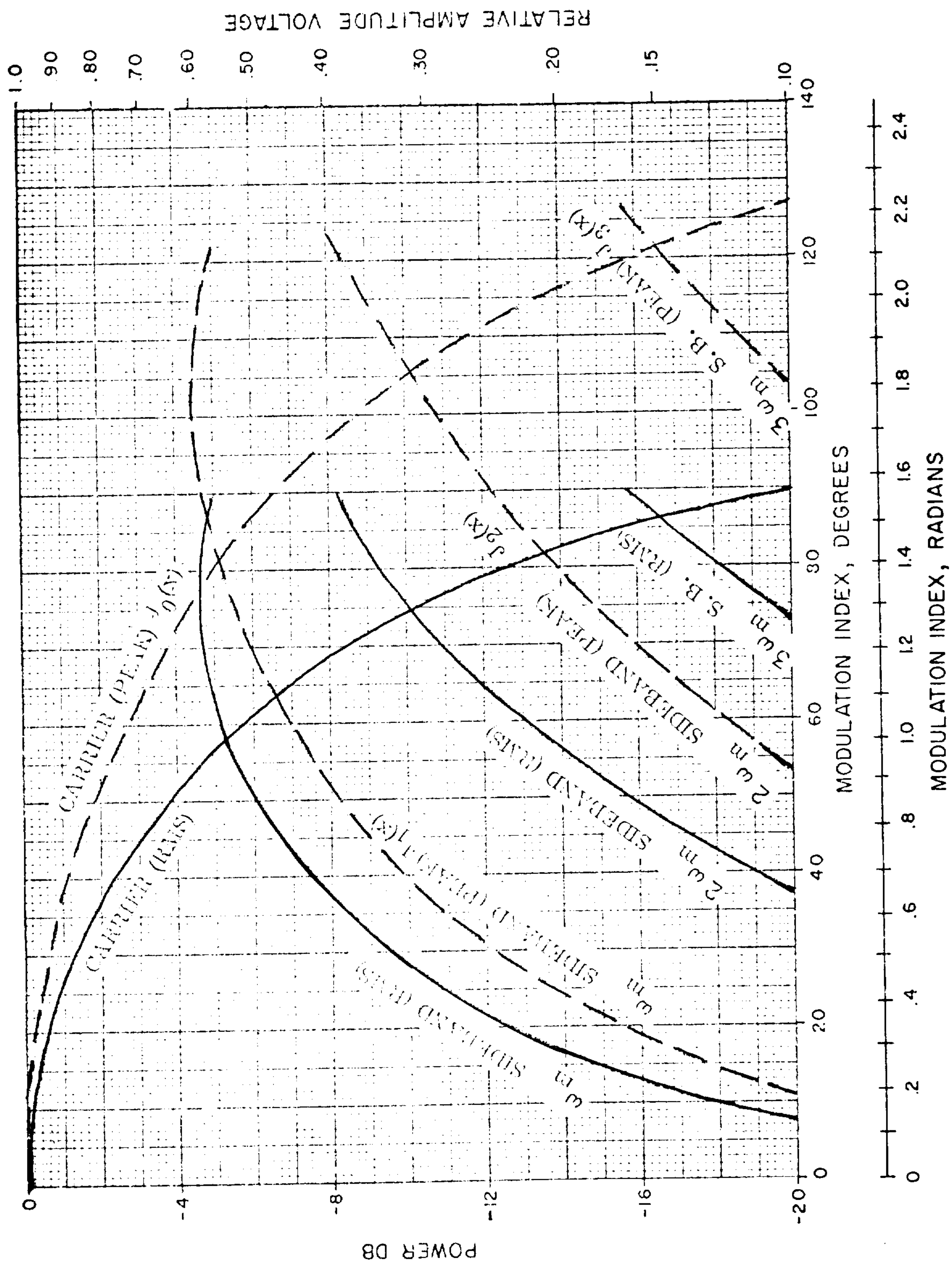


Figure 7-4. Simplified Bessel Functions for Sine Wave or Composite Wave

d. Finding Modulation in Radians. The following example demonstrates how to find radians of modulation for 7-dB carrier suppression:

Example:

$$7 \text{ dB} = 20 \log \frac{1}{E}$$ E is to be found.

E = 1, same as in step c.

$$\frac{7}{20} = \log \frac{1}{E}$$

$$.35 = \log \frac{1}{E}$$

$$\text{antilog } (0.35) = \frac{1}{E}$$

$$2.44 = \frac{1}{E}$$

$$E = \frac{1}{2.24} = 0.446$$

This is the value of ordinate, and reading the $J_0(x)$ curve, this value of 0.446 on the ordinate corresponds to a value of 1.6 radians on the abscissa, so the answer is 1.6 radians of modulation for 7-dB carrier suppression.

e. Square Wave Modulation; One Subcarrier. The curves ω_c, ω_m, $3\omega_m$, and $5\omega_m$ in figure 7-5 represent the carrier, first, third, and fifth sidebands. Where the ω_c curve intersects the ω_m curve, the abscissa is 1.01 radians, which is the modulation index. The ordinate at the intersection of ω_c and ω_m is approximately 5.4 dB (left-hand ordinate) and 0.54 (right-hand ordinate) to calculate the carrier suppression and modulation index in radians. (Refer to para 7.5.4.4c and d for examples.)

7.5.5 S-BAND DOWNCONVERTER UHF/VHF MODULATION MEASUREMENT

The downconverted FM modulation can be measured at the plus and minus 3-dB points using 10 MHz as a reference; examples as follows (see figure 7-6):

a. At HP-8443A, set left marker to 3-dB point. Record frequency (e.g., 9.9 MHz).

b. At HP-8443A, set right marker to 3-dB point. Record frequency (e.g., 10.1 MHz).

c. Peak-to-peak deviation is 10.1 MHz minus 9.9 MHz which equals 200-kHz peak-to-peak deviation.

d. Divide by 2 to obtain peak deviation.

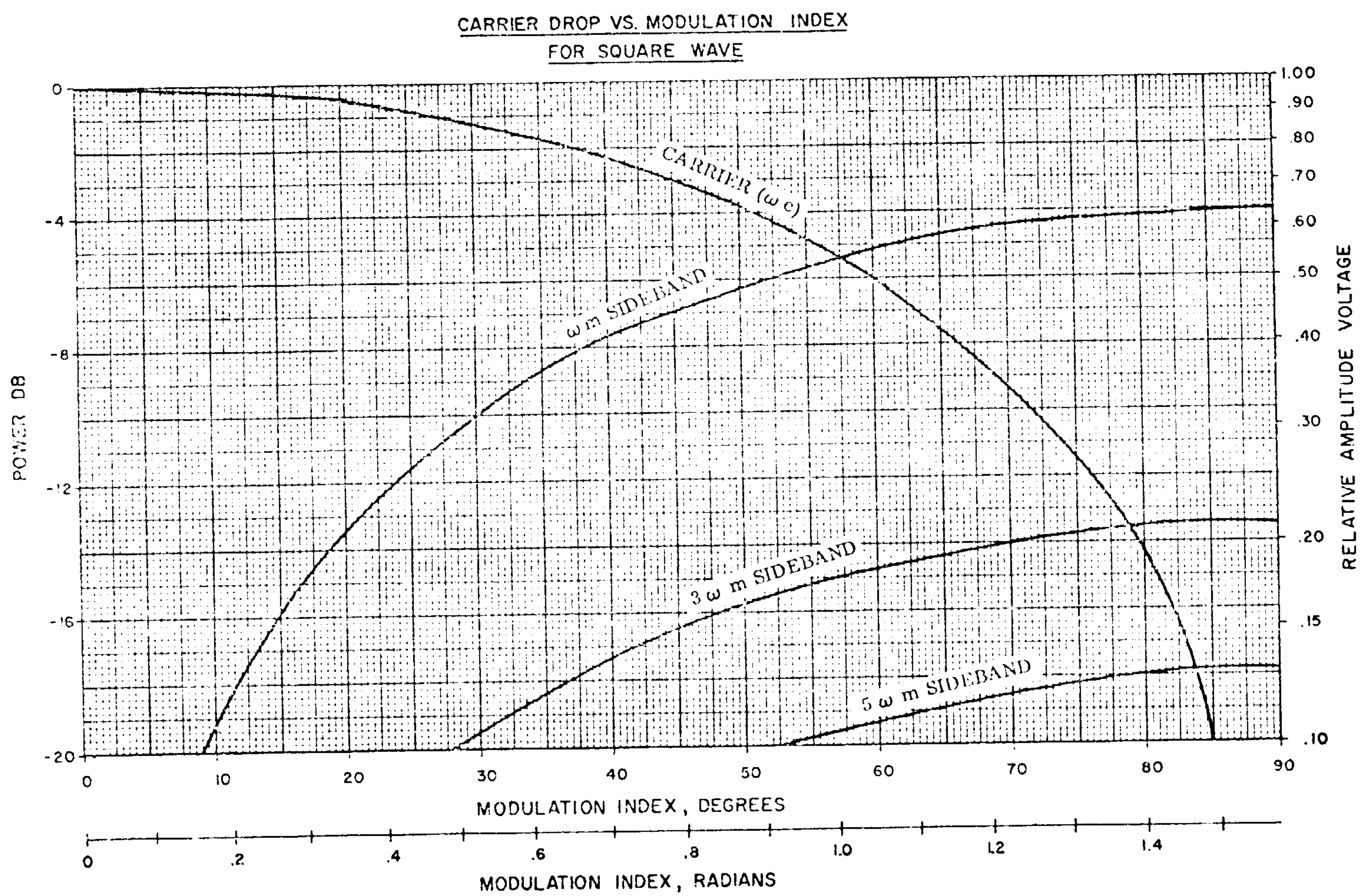


Figure 7-5. Carrier Drop vs Modulation Index for Square Wave

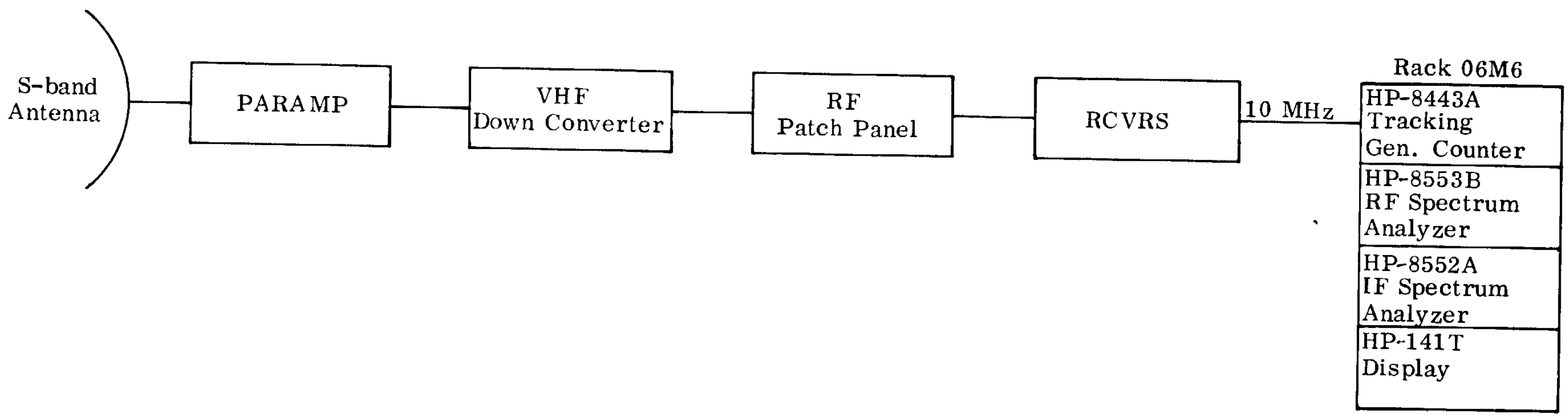


Figure 7-6. Typical S-band/VHF Measurements Setup

7.6 FM DATA REMOTING PROCEDURES

7.6.1 GENERAL

Multiplexed IRIG SCO 1 through 7 can be used for remoting up to seven data parameters simultaneously. In addition to the seven parameters, if timing is required, IRIG SCO 8 deviated from LBE to CF can be used. FM levels for data leaving the station are nominally -10 dB below 0 dBm ±3 dB.

7.6.2 OPERATING PROCEDURES

7.6.2.1 Output Amplitudes. Monitor the mixer outputs on a spectrum display unit and adjust all subcarrier amplitudes for equal amplitude before allowing the data to be output or remoted. If the composite output level of the mixer is too low for the external equipment, use a suitable amplifier such as the HP Model 467A between the mixer output and the external input. Connect the spectrum display unit to the amplifier output to ensure that the subcarriers are of sufficient and equal amplitudes.

7.6.2.2 Remoting Tests. Prior to FM support, a remoting test to demonstrate system integrity, line confidence, and/or data identification is often required by the using agency. To standardize equipment interface, the following equipment configurations will be used:

a. Configuration 1 (for PCM-derived FM Data). Figure 7-7(A) illustrates the proper configuration for PCM-derived FM data. Either a simulator or a magnetic tape is preferable as the data source; if neither is available, use the DAC calibrator for 0 and 100 percent, or the Data Converter Multiplexer (DCM) internal calibrator with 0-, 25-, 50-, 75-, and 100-percent steps.

b. Configuration 2 (for FM Subcarrier-derived FM Data). Figure 7-7(B) illustrates the proper configuration for FM subcarrier-derived FM data. Either the DCM or a magnetic tape is preferable as the FM source; if neither is available, use the DCM internal calibrator.

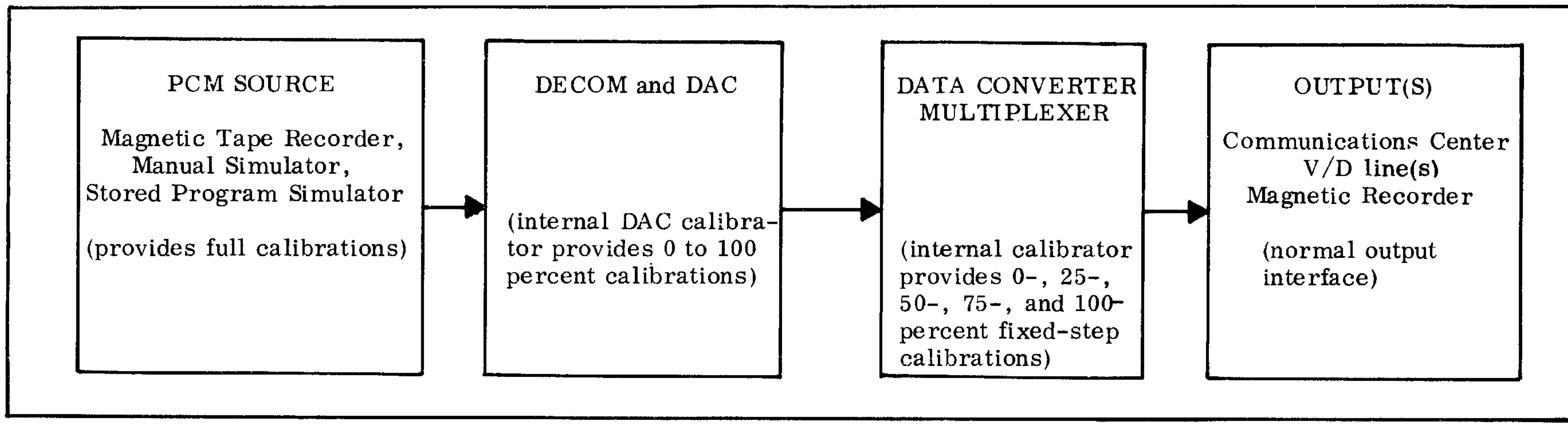
Note

1. Unless otherwise specified, the step calibrations begin with each channel at center frequency (50 percent) for 10 seconds, then sequentially step from 0 to 100 percent with a 10-second step dwell period.

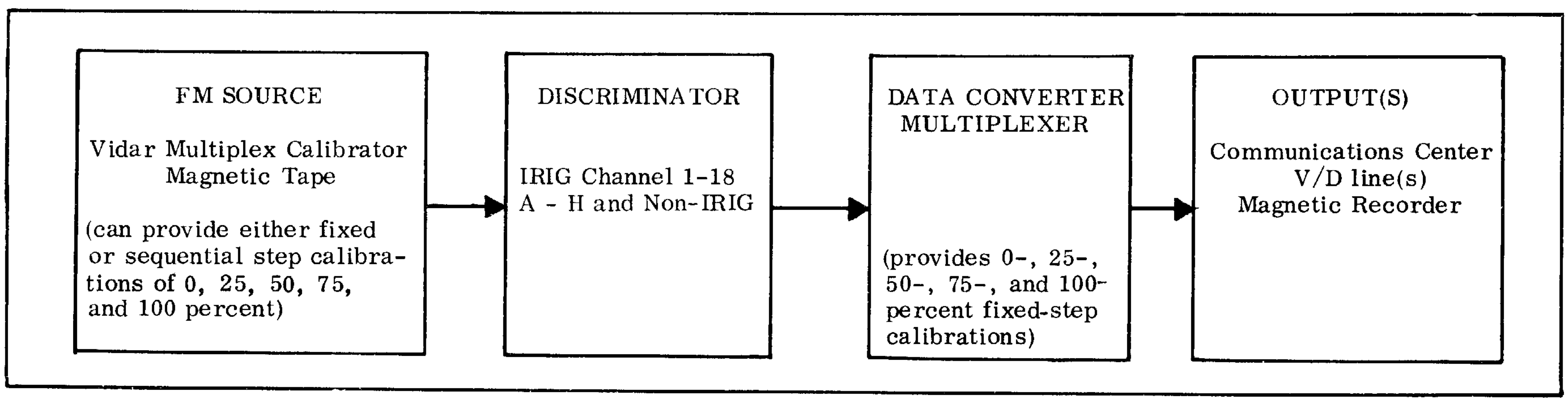
2. The FM channels to be remoted, and any special sequence of remoting, will be specified in the NOSP.

3. The spectrum display unit (TA-1000 or equivalent) will be paralleled to the mixer output for monitoring the subcarrier frequency amplitudes.

4. When station equipment is available, mixer outputs should be routed in parallel to the on-station discriminators and recorded on a chart recorder for station reference.



A. Configuration 1 (PCM-derived FM Data)



B. Configuration 2 (FM Subcarrier-derived FM Data)

Figure 7-7. Flowcharts for PCM- and FM Subcarrier-derived FM Data

7.6.3 CALIBRATIONS

All VCO's will be calibrated as closely as possible to ±7.5 percent (IRIG 1-18) and ±15 percent (IRIG A-H). The data source for calibration will be in accordance with the VCO input requirements as specified in the NOSP. The following calibration procedures (using the timing source as an example) will be followed:

a. Calibrate a discriminator (set for the frequency of the VCO) using the Vidar as the source.

Note

> Ensure that the output filter selected for the discriminator is capable of passing the input modulating frequency.

b. Connect an oscilloscope to the output of the discriminator and adjust it so that the VCO center frequency is centered on the Cathode Ray Tube (CRT).

c. While deviating the discriminator to the high and low bandedges with the Vidar, adjust the oscilloscope controls for an easily defined vertical reference above and below center and observe the trace position.

d. Remove the Vidar and patch the output of the VCO mixer to the input of the discriminator. (Patch the mixer according to the NOSP.)

7.7 DDPS/AMQ PROCEDURE

7.7.1 GENERAL

Specific analog parameters to be remoted in DDPS data blocks for user information are required for most missions now being supported by the STDN. These parameters include, but are not limited to, the following information: selected analog voltages such as fuel cell pressures, engine chamber pressures, and receiver AGC voltages.

7.7.2 AMQ CHANNEL ASSIGNMENTS

7.7.2.1 Specific AMQ channels are assigned in section 1 or 2 of the applicable NOSP.

7.7.2.2 Actual AMQ channel-to-642B computer/TDC allocation is performed by computer software by means of I/O 1232 keyboard entry.

7.7.2.3 Patching by telemetry technicians is performed for each individual mission as outlined in the applicable NOSP.

7.7.2.4 Testing may be performed by EMD(1)-PET-459 or EMD(2)-061-354.

7.7.2.5 Front-panel controls and nominal switch settings are outlined in section 4.

7.7.3 RECEIVER AGC CURVES

Table 7-4 lists nominal AGC voltage curve, AMQ octal, and RF reference levels for MFR receivers that have been modified by EC 2210 to provide 0 to +8 V output.

Note

> Each station should have a valid set of receiver AGC curves for each MFR receiver/antenna combination.

Table 7-4. Standard MFR/AMQ AGC Readings

RF Level (dBm)	AGC Voltage (volts)	AMQ Reading (octal)
-50	+ 0.000	000
-60	0.666	021
-70	1.332	042
-80	1.998	063
-90	2.664	104
-100	3.330	125
-110	3.996	146
-120	4.662	167
-130	5.328	210
-140	5.994	231
-150	6.660	252
-160	7.326	273
-170	7.992	315

7.8 PAM/PDM PROCEDURES

7.8.1 GENERAL

The requirement occasionally exists to process PAM/PDM parameters downlinked by some launch vehicles. These parameters are generally identified as mark events identifying fairing jettison or payload separation. These mark events are stripped by the stations, recorded on stripchart recorders, and remoted off station as specified in the applicable NOSP.

7.8.2 PAM/PDM DATA HANDLING EQUIPMENT

7.8.2.1 A Krohn-Hite filter can be used to precondition the PAM/PDM data input to the DDF-13 which processes the data and distributes to DAC-13 for display and provides a serial output which may be patched to a PCM decom.

7.8.2.2 The SS-13 simulator is used for testing, and can be patched by the TLM technician directly to the DDF-13 or through the RF loop. The DAC output is available at the patchpanel for connection to stripchart recorders.

7.8.2.3 See figure 7-8 for typical PAM/PDM configurations.

7.8.3 EQUIPMENT SETUP AND TESTING

Front-panel controls with nominal settings are described in section 4. Mission-unique information such as channel assignments, data rates, and pulsewidths are given in the applicable mission NOSP. System testing is accomplished by performing the PAM test which is fully described for 642B interface in the SCAN Control No. 6-059 DOTS program, and EMD(2)-06K-311.

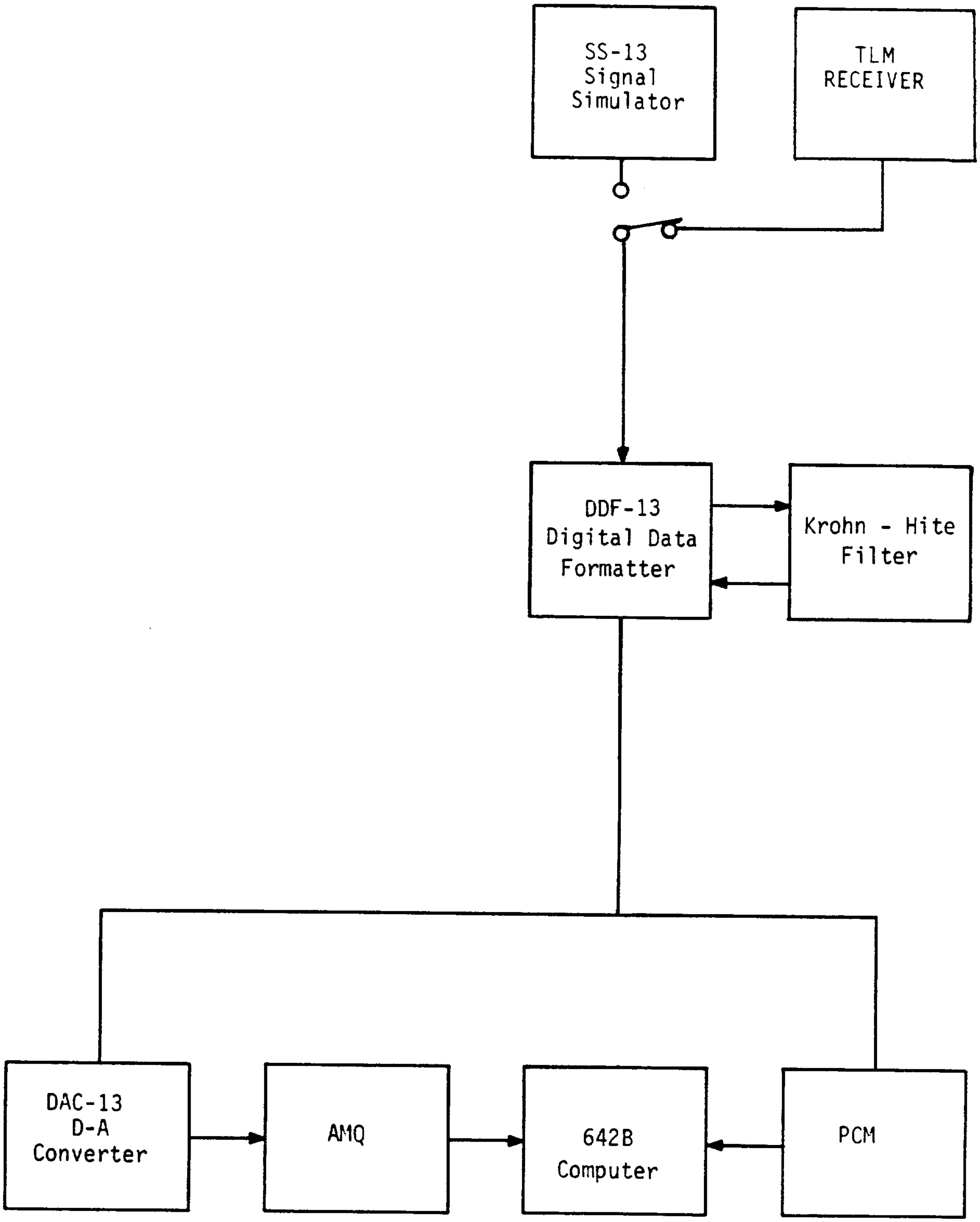


Figure 7-8. Typical PAM/PDM Configuration

7.9 DATA REMOTING/DTS SYSTEMS

7.9.1 GENERAL

In addition to, or in lieu of, computer interface or remoting data off-station, some STDN stations use a Data Transmission System (DTS) for remoting data. The DTS is an interface between the data handling equipment and the data modem. Data transmission encoders are used to generate NASCOM data blocks of preselected lengths which include header, data sync, time sync, time tag, fill sync and fill bits, or data. The specifications, front-panel control settings, and nominal control settings for encoders E9, E111, and E111A are listed in section 4.

7.9.2 DTS REMOTING PROCEDURES

7.9.2.1 Prepass Verification and Setup

a. Begin prepass verification at a time specified by the operations controller.

b. Ensure that data link is available to GSFC.

c. Install the specified patchboard in the encoders as specified in the applicable NOSP.

d. Set the HEADER thumbwheel switches to the positions indicated in the applicable NOSP.

e. When data is to be transmitted, adjust the bit synchronizer as necessary to obtain synchronization.

Note

> Encoder memory should be cleared prior to off-station transmission as follows:
>
> 1. E9 and E111. Set SERIAL DATA GO toggle switch to OFF, then to ON.
>
> 2. E111A. Momentarily press the RESET button.

7.9.2.2 Pass Operation

a. Monitor the assigned intercommunications network to receive special instructions from the operations supervisor.

b. Stand by to change the bit synchronization and encoder settings as required.

7.9.2.3 Postpass Operation. Stand by to provide postpass playck support if required.

7.10 EQUIPMENT CONFIGURATION FOR MSFTP-3 STAND-ALONE SUPPORT

7.10.1 GENERAL

7.10.1.1 The MSFTP-3 serial output is used to transmit data off station. Two basic data types are normally transmitted.

7.10.1.2 DTS data is transmitted without using a Block Error Detector (BED).

7.10.1.3 Currently, 1200-bit blocks are in use for NASCOM data blocks, and some software is being developed for 4800-bit blocks. The data blocks are transmitted through a BED to provide Polynominal Error Protection (PEP) encoding. The BED provides PEP encoding for 1200-, 2400-, 4800-, and 9600-bit blocks.

7.10.2 DTS DATA

7.10.2.1 MSFTP-3 Setup

a. Set the FREQUENCY SYNTHESIZER/EXTERNAL switch to EXTERNAL.

b. Set the MODEM switch up. This supplies the Request to Send (RS) and Clear to Send (CS) signal interface between the MSFTP-3 and modem.

7.10.2.2 External Interface

a. Connect the clock of the modem to be used to the MSFTP-3 external clock input (J56 on the I/O panel). If the clock from the modem is interrupted, the decom should be reinitialized to nominalize the output data.

b. Connect the MSFTP-3 serial output data (J54 on the I/O panel) to the modem supplying the external clock.

c. Interface the modem to the appropriate data link (7.2 kb/sec is nominal for DTS).

7.10.2.3 Data Transmission

a. Refer to the software sequence TESOC for operating instructions.

b. The serial output may be monitored using a decom or frame sync. DTS data is continuous and normally contains a NASCOM sync pattern every 1200 bits.

c. The MSFTP-3 serial output data is inverted.

7.10.3 BLOCK DATA

7.10.3.1 MSFTP-3 Setup

a. Set the FREQUENCY SYNTHESIZER/EXTERNAL switch to EXTERNAL.

b. Set the MODEM switch up. This supplies the RS and CS signal interface to the BED.

7.10.3.2 External Interface

a. Connect the clock from the BED to the MSFTP-3 external clock input.

b. Connect the MSFTP-3 serial output data to the same BED used for the clock interface.

c. Select the required block length with the BED front-panel switch.

d. The GCC provides the interface from BED to modem. This interface includes the clock, data, RS, and CS signals.

e. The modem used to transmit the data off-station must be the clock source for the MSFTP-3 external clock input.

f. Interface the modem to the applicable data link (7.2, 56, 224 kb/sec). If the clock from the modem is interrupted, the decom should be reinitialized to normalize the output data stream.

7.10.3.3 Data Transmission

a. Refer to the software sequence TESOC for operating instructions.

b. The serial output may be monitored using a decom or frame sync. The block data may be either continuous or burst and the number of blocks contained in a burst may be one or more. To obtain maximum monitoring capability, the decom or frame sync used must be capable of locking onto burst data. EC's have been issued for the MSFTP-3 decom and several frame syncs to provide burst operation.

c. The MSFTP-3 serial output data is inverted.

d. When performing station equipment configuration tests or software checkout, off-station data transmission must be inhibited.

e. The frequency synthesizer clock may be set to the applicable rate and used for onstation testing.

7.11 PCM DATA WORD READOUTS

7.11.1 STDN stations processing synchronous PCM data are often required to provide real-time or near-real-time (via tape PB) readouts of specific SC analog or event data parameters. The analog values are given in decimal unless specified otherwise in the NOSP (e.g., binary, octal, or percent of full scale). If binary or octal readouts are required, they are read from left to right as they appear on the binary display unless specified otherwise in the NOSP. Event parameter readouts are given as 1 for the specified bit being set or for the bit not being set.

7.11.2 The bit numbering is as follows: As the word appears on the display, the left-most bit of the word is bit number 1 and the right-most bit of the word is bit number 8, assuming an eight-bit word. For example, in XXOXXXXX, the 0 is bit number 3.

7.11.3 Paragraphs 7.12 through 7.14 outline the parameter readout capabilities available at the control panel of each PCM decom plus the total capability via peripheral display equipment.

7.12 MSFTP-2 DECOMMUTATOR

7.12.1 GENERAL

Words are selected by absolute address accessing. The word and frame versus address are contained in PCM program listings or may be specified in applicable NOSP referencing quick-look parameters.

7.12.2 DATA MONITOR PANEL

The data monitor panel displays are as follows:

a. Two 6-digit decimal display units, each capable of selecting 3 through 20 bits of any programmed data word for conversion to decimal display. Switch selection displays the decimal values of the PCM ID sync word when used.

b. Binary display provides a display of up to 32 data word bits. A binary 1 lights the indicator in the respective bit position of the data word selected for display. By manual switch selection, the PCM ID sync word can be displayed.

c. A digital-to-analog selector allows selection of eight MSB's of any data word preprogrammed for digital-to-analog conversion for display on a five-digit voltmeter. An eight-bit word is quantized to 255 incremental steps from 0 to +10 volts. The converted output always puts the first MSB at 50 percent of the quantized output, the second MSB at 25 percent.

7.12.3 PERIPHERAL DISPLAY

MSFTP-2 peripheral displays are as follows:

a. 63 DAC outputs.

b. 124 digital store (event) outputs.

c. 20 binary store outputs of 10 bits each.

Note

All peripheral displays are not interfaced at all stations.

7.13 DHS DECOMMUTATOR

7.13.1 DATA MONITOR PANEL

7.13.1.1 The data monitor panel displays are as follows:

a. Twenty displays of distinct parameters on the channel selectors, either in octal or decimal.

b. One parameter in binary. The binary display is operated by setting in the data tag of the selected word. All bits of the word will be shown (32 bits maximum).

7.13.1.2 The channel selectors are called up by setting in the data tag assigned to the word by stored program. In addition, the word length (9-bit maximum) is selected using the START-STOP switches to select the first and last bits (in time sequence) of the word. Data tag assigned to specific word/frame is contained in the PCM listing.

Note

For multiple selection of syllables from the same word, the start-stop bits must not overlap.

7.13.1.3 If the data tag for a desired word is unknown, it can be found in the program listing and/or TESOC if the mainframe/subframe format location of the word is known. A toggle switch selects either decimal or octal display.

7.13.2 PERIPHERAL EQUIPMENT

DHS peripheral equipment displays are as follows:

a. A chart recorder with eight pens. Each pen can be selected by a patchpanel. The 52 D-A converters that drive the channel selectors have outputs available at this patchpanel. The pens record the reading of the channel selector, using data tag selection.

b. A printer is also available. The only access to the printer is through stored instruction.

c. A punch, located below the printer. It will dump simulator or decom memory on front-panel demand, but will punch data only by stored instruction.

d. Channel stripping pulses, binary stores, and other data control pulses are available at various pin jacks. More detailed information on these is available in the equipment manual.

7.14 MSFTP-3 DECOMMUTATOR

7.14.1 DATA MONITOR PANEL (DISPLAYS/BE TEST PANEL)

Displays are as follows:

a. MSFTP-3 utilizes absolute SC word, frame, subframe dial-up capability listed in TESOC or applicable NOSP.

Note

Refer to TESOC for any required modification to downlink addressing.

b. Two 6-digit decimal display units, capable of displaying decimal (normal) or BCD (bypass) of any PCM data word.

c. Binary display, providing display of up to 32 bits. A binary 1 lights the indicator in the respective bit position.

7.14.2 DAC PANEL

The DAC panel provides test points for monitoring of the 31 programmable DAC's. The DAC's act on the eight LSB's of the accumulator.

7.14.3 PERIPHERAL DISPLAY

MSFTP-3 peripheral displays are as follows:

Note

Not all peripheral displays are interfaced at all stations.

a. Thirty-one DAC outputs. First 16 SENSE selectable (voltage inversion).

b. Thirty-one digital (event) store outputs.

c. Four binary store (10-bit words) outputs.

d. Parallel data output.

e. Serial data output.

7.15 DDPS DATA MONITORING

7.15.1 GENERAL

With the near-universal use of the DDPS as the method of HSD transmission, the need for onstation monitoring of transmitted data streams has become apparent. The Monitor 400 decom, MSFTP-2 decom, MSFTP-3 decom, and 403 frame sync may be used to monitor DDPS blocks. Using such equipment, the DDPS data streams can be monitored for correct header information and, in many cases, the telemetry data can be examined to isolate station equipment problems. The MSFTP-2 simulator can be used to generate DDPS blocks in continuous or burst mode to verify monitoring equipment and possibly to verify HSD lines and DDPS receive equipment.

7.15.2 DDPS BLOCK FORMAT

7.15.2.1 Reference Information. Station personnel should become familiar with the applicable section (21, 21A, 21B, 21C) of STDN Network Operations Procedures for Network Computer Systems, STDN No. 502.5 for the current phase of DDPS. Information on the different block formats and codes used in the header information are included. In this section, emphasis is on 1200- and 4800-bit telemetry data blocks. See figure 7-9 for a description of the PCM/CMPTR status word.

7.15.2.2 DDPS Block Word Numbering. DDPS blocks are commonly divided into 16-bit words. Figure 7-10 illustrates word numbering for a 1200-bit block with 16-bit words. Figure 7-11 illustrates the word numbering for a 4800-bit block divided into 16-bit words. Blocks can be further divided into 8-bit bytes to be compatible with the Monitor 400 decom and to be more convenient for verifying header information. Figure 7-12 illustrates word numbering for the 1200-bit block with 8-bit bytes and figure 7-13 illustrates word numbering for a 4800-bit block with 8-bit bytes.

7.15.2.3 DDPS Telemetry Data Block Components. Both the 1200- and 4800-bit blocks contain the following:

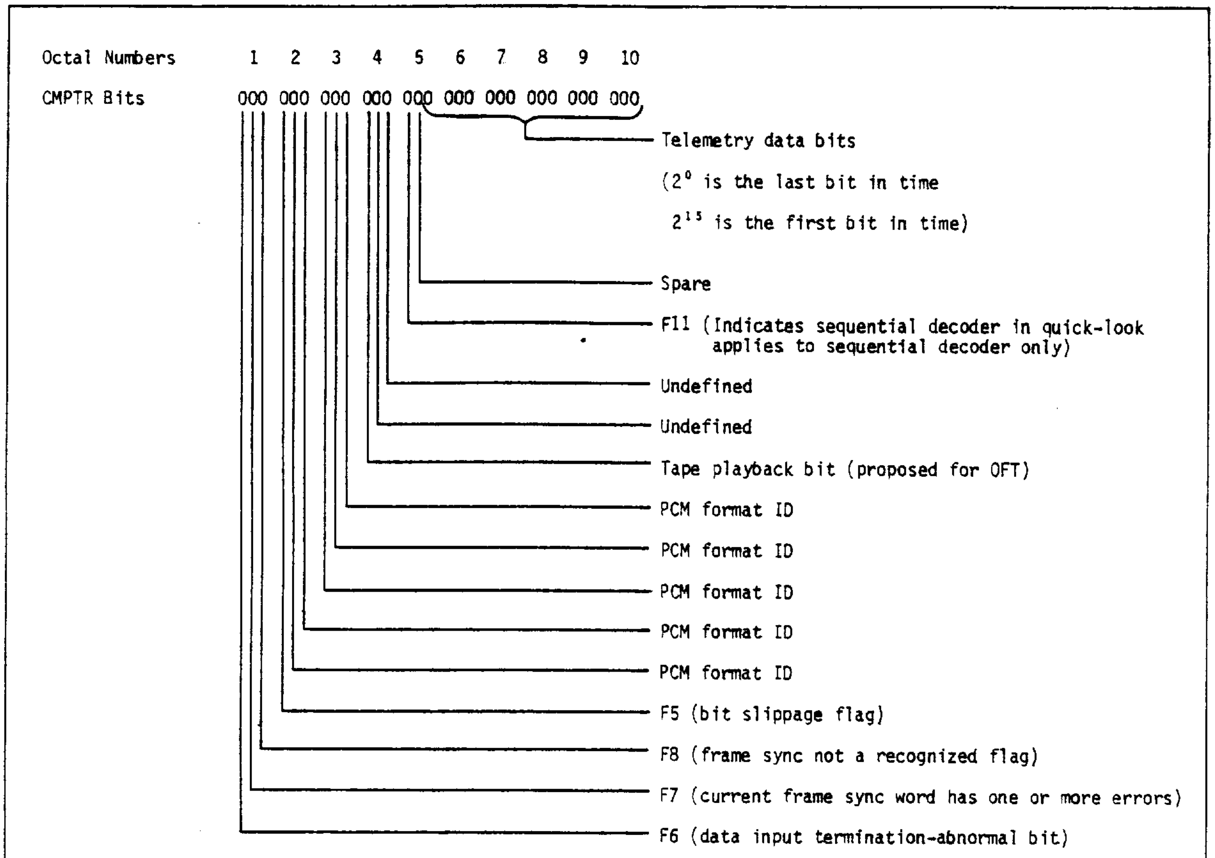
a. Header. The header contains information identifying the start of the block, source and intended destination, format and contents, and identification. It consists of the first 96 bits of the DDPS block which can be divided into six 16-bit words or twelve 8-bit words. Refer to the applicable section (21, 21A, 21B, 21C) of STDN No. 502.5 for a detailed description of header information and a list of codes used.

b. Message Data

(1) For telemetry type 1 data blocks, the message data portion contains the actual data from a decom. It is 1072 bits long for 1200-bit blocks and 4672 bits for 4800-bit blocks.

(2) For 16-bit words, the first word of telemetry data in the block would be word 7; for 8-bit words, the first word is 13.

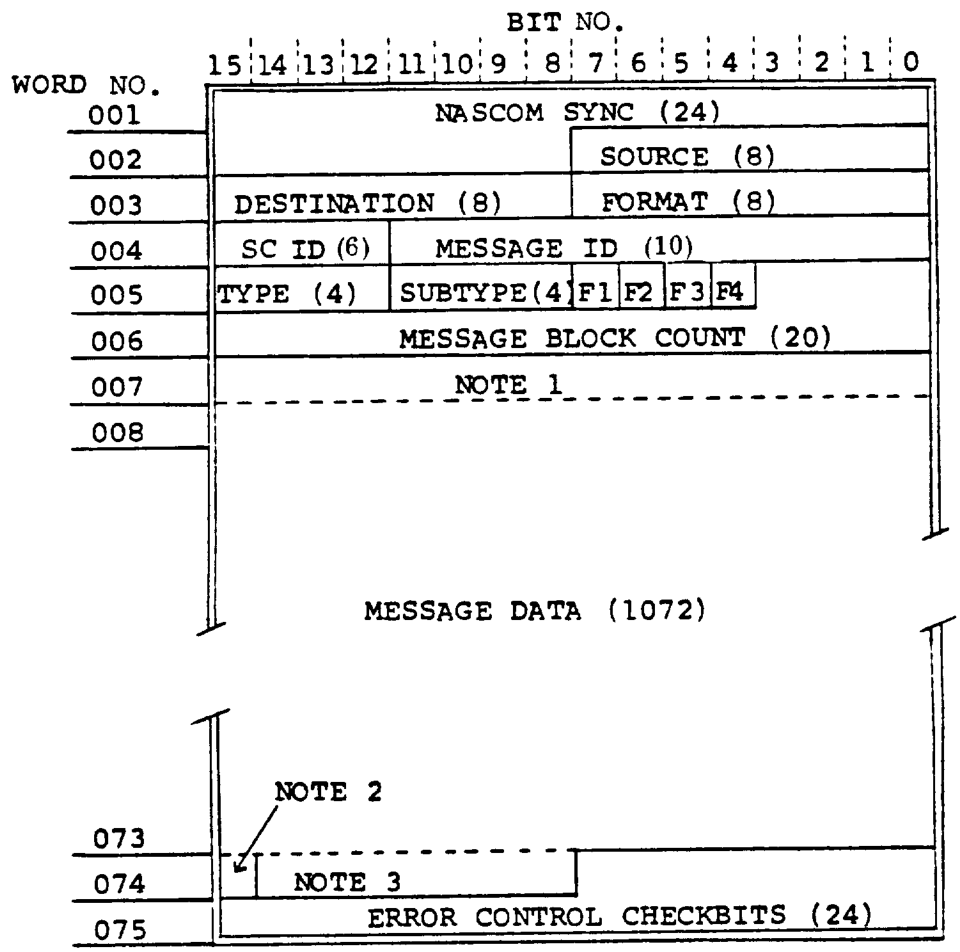
(3) If the frame length of the telemetry format is short enough to be inserted in the message data portion (along with the station time and flags), then each telemetry data block will contain one frame of data. If the frame is too long to be contained in one block, then the frame will be divided into two or more blocks. In that case, time and flags would immediately follow the last word of the frame in the last block containing a portion of the frame.



Note

1. Currently, bits 2^{16} through 2^{20} depend on the DHE in use. Voltage levels at the DHE/CMPTR interface will determine the bit value (1 or 0).
2. Bit values of octal digit number 4 are undefined.
3. The MSB of octal digit 5 is significant if the sequential decoder is in use. The middle bit of octal digit 5 is undefined.
4. The LSB of octal digit 5 is the first bit in time of the 16 telemetry data bits.
5. Bits 2^0 through 2^{15} are normally the PCM frame sync pattern. Occasionally this is not true due to project requirements. Up to 15 bits of this transfer can be fill bits (0's), although bit 2^{15} will never be a fill bit. The 16 telemetry data bits will be the last bits transferred to the computer at time of elevation.

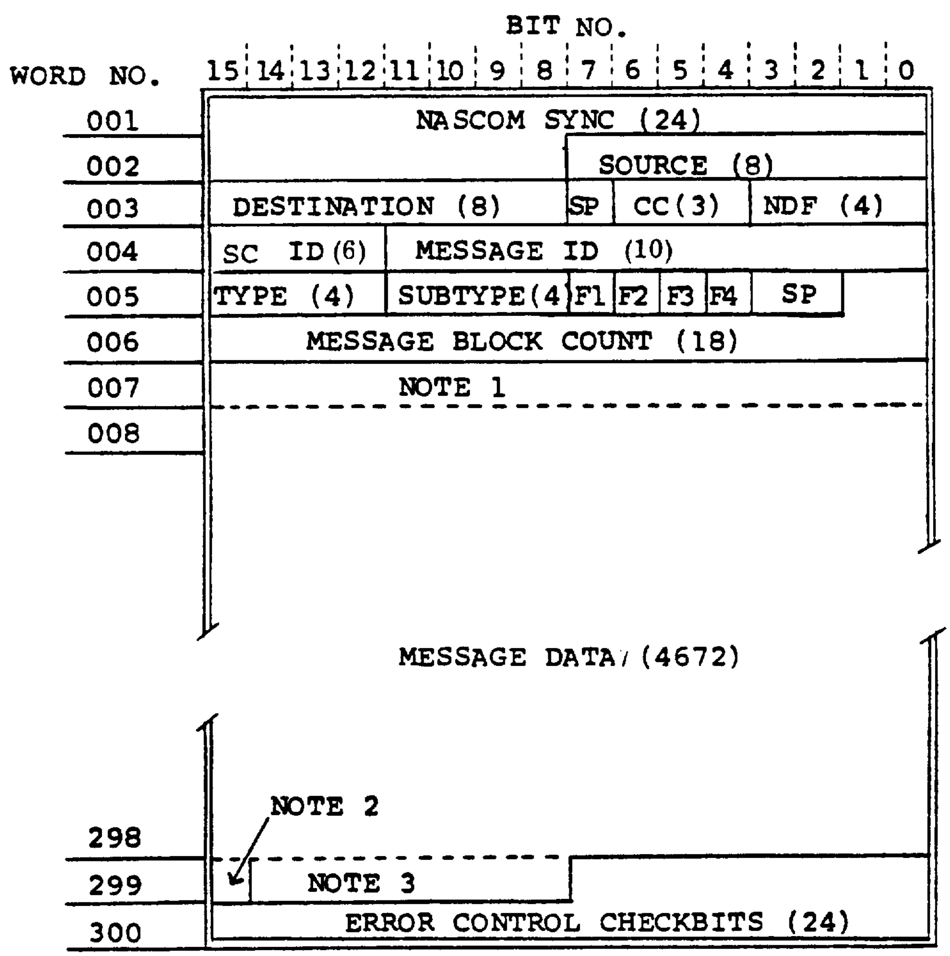
Figure 7-9. Description of the PCM/CMPTR Status Word



Note

1. For telemetry blocks, these are the first 16 bits following the frame sync word.
2. For telemetry blocks, this bit is a 0.
3. For telemetry blocks, this is the Block Sequence Count (BSC).

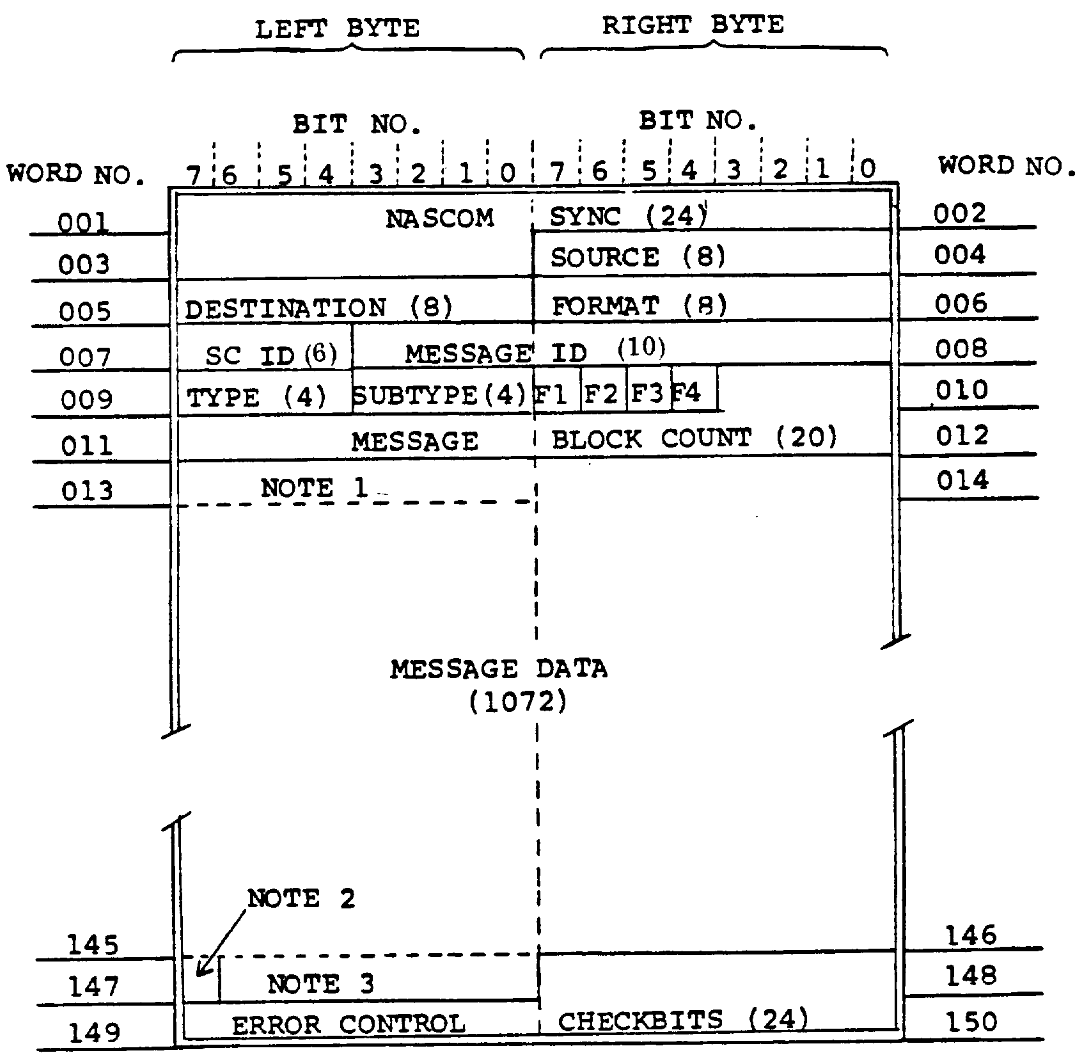
Figure 7-10. 1200-bit DDPS Block with Word Numbers for 16-bit Words



Note

1. For telemetry blocks, these are the first 16 bits following the frame sync word.
2. For telemetry blocks, this bit is a 0.
3. For telemetry blocks, this is the BSC.
4. SP = spare bits, CC = cyclic count.

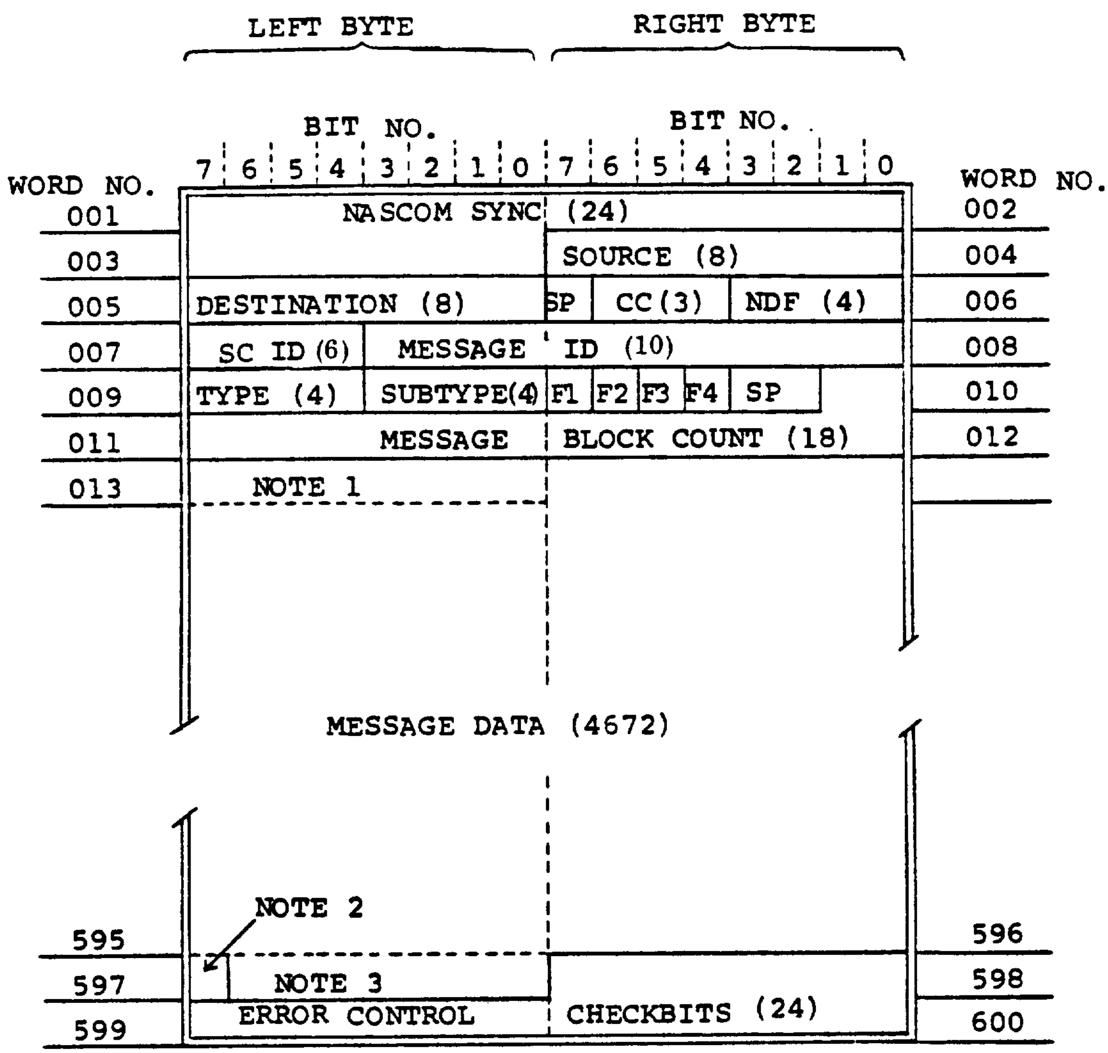
Figure 7-11. 4800-bit DDPS Block with Word Numbers for 16-bit Words



Note

1. For telemetry blocks, these are the first eight bits following the frame sync word.
2. For telemetry blocks, this bit is a 0.
3. For telemetry blocks, this is the BSC.

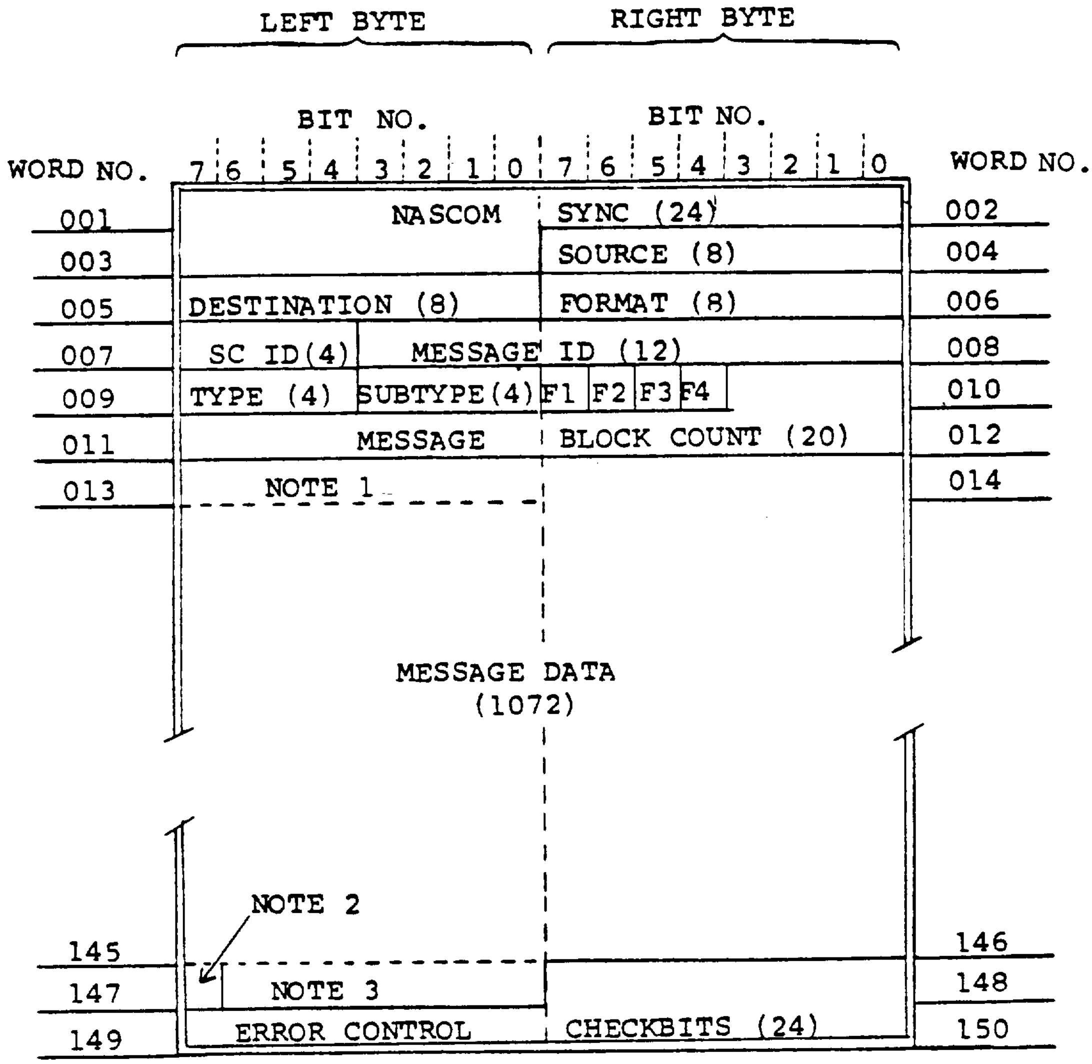
Figure 7-12. 1200-bit DDPS Block with Word Numbers for 8-bit Bytes



Note

1. For telemetry blocks, these are the first eight bits following the frame sync word.
2. For telemetry blocks, this is a 0.
3. For telemetry blocks, this is the BSC.
4. SP = spare bits, CC = cyclic count.

Figure 7-13. 4800-bit DDPS Block with Word Numbers for 8-bit Bytes



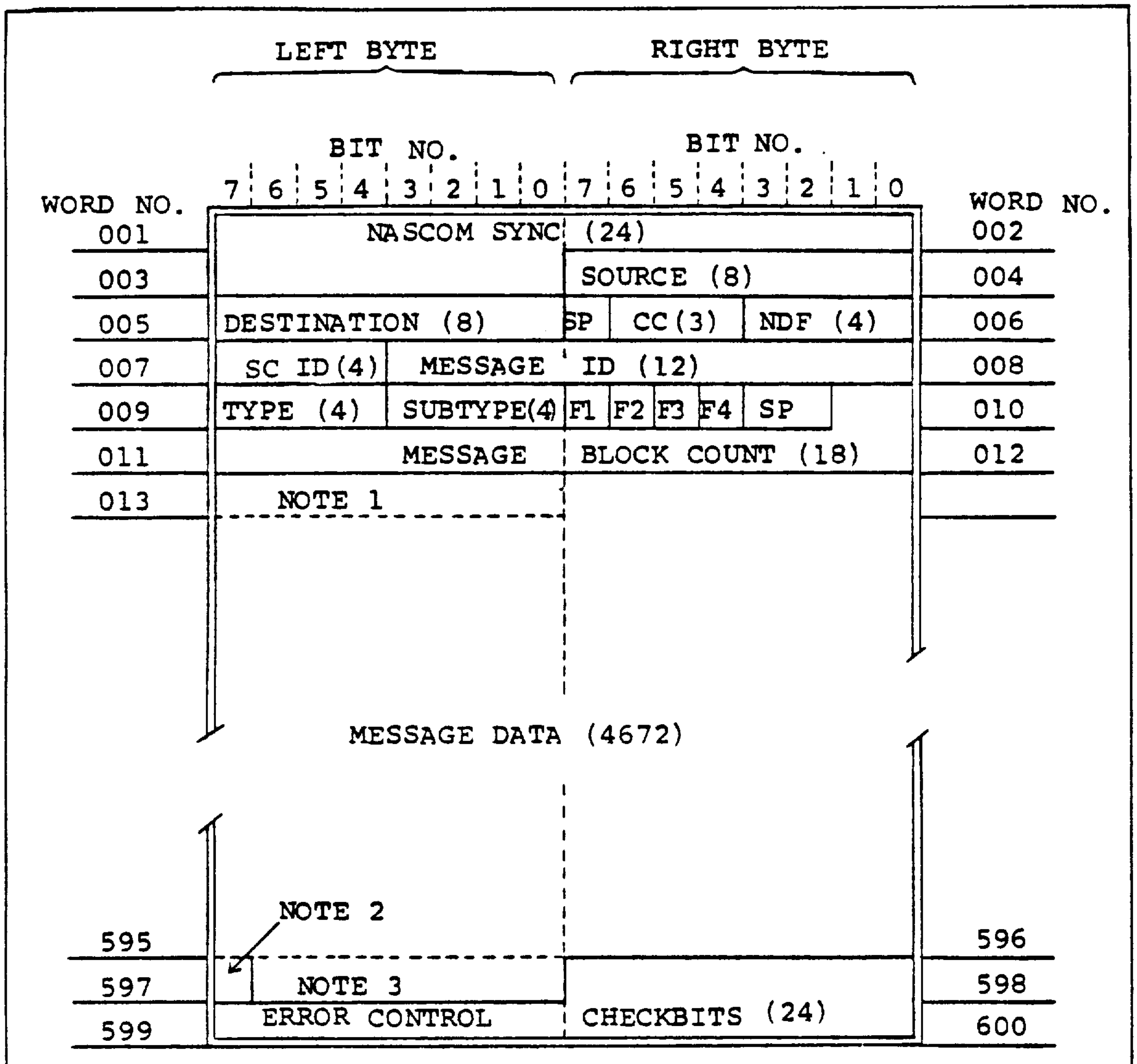
Note

1. For telemetry blocks, these are the first eight bits following the frame sync word.

2. For telemetry blocks, this bit is a 0.

3. For telemetry blocks, this is the BSC.

Figure 7-12. 1200-bit DDPS Block with Word Numbers for 8-bit Bytes



Note

1. For telemetry blocks, these are the first eight bits following the frame sync word.

2. For telemetry blocks, this is a 0.

3. For telemetry blocks, this is the BSC.

4. SP = spare bits, CC = cyclic count.

Figure 7-13. 4800-bit DDPS Block with Word Numbers for 8-bit Bytes

(4) Multiple frames can also be packed into two or more blocks. For example, if two frames are packed into three blocks, the first block would contain a portion of the first frame; the second block would contain the remaining portion of the first frame and a portion of the second frame; and the third block would contain the remaining portion of the second frame followed by station time and flags.

(5) Time is a consideration in packing blocks. On slow data rates, a frame which is short enough to be contained in one block can be divided between two or more blocks to ensure that the time involved in packing the frame does not delay the data.

(6) Telemetry data can be packed either synchronously or asynchronously. If packing is asynchronous, then the start of a frame can appear anywhere within the message data portion of the block and data words cannot be related to their positions in the block. In this mode, monitoring data contents is impossible with the present equipment. More often, however, telemetry data is packed synchronously, i.e., in blocks according to regular schemes similar to those described in para (3), (4), and (5). In such cases, data is regularly resynchronized to the start of the block and, at regular intervals, the first bit of the message data portion would contain the first bit of a frame following an EI. If each block contains an entire frame, then the telemetry data is resynchronized to the block once per block and the first bit of the message data portion of every block would contain the first bit of the frame. If one or two frames are contained in three blocks, then in every third block the first bit of a frame would correspond to the first bit of the message data portion.

(7) Normally, the station DDPS processor does not rearrange telemetry data. It is packed in DDPS blocks in the order in which it is received, starting with the first word following an EI. The listing for the decom program being used may be used as a reference to determine which data words are being transferred and the sequence in which they are transferred.

(8) If a frame, including time and flags, does not entirely fill the message data portion of the block, then the time will be followed by two 8-bit words containing 311_8 and the remainder will be undetermined fill. This will also be the case in multiple block formats when required.

(9) Section 5 of the NOSP for the mission to be monitored contains diagrams illustrating the packing of the blocks for each project data format associated with the mission.

c. BSC. The BSC is used in conjunction with the packing of multiple block formats. It is contained in bits 1169 through 1176 in 1200-bit blocks and in bits 4769 through 4776 in 4800-bit blocks. The first bit is a spare and always 0. The BSC is used to indicate the position of the block in the data stream for multiple block formats. It counts from 000 to 177_8 . If an entire frame is packed in one block, then all blocks will contain a BSC of 000. If one or two frames are packed in three blocks, the first block would have a BSC of 000. The second block would have a BSC of 001 and the third block would have a BSC of 002. Formats may have sequences of up to 128 blocks.

d. PEP Code. The PEP code is used by NASCOM Block Error Detectors (BED) to detect errors generated in the transmission circuit. It is contained in bits 1177 through 1200 in 1200-bit blocks and in bits 4777 through 4800 in 4800-bit blocks. The first two bits of the code (1177 and 1178 or 4777 and 4778) are PEP decoding flags. The transmitting DDPS processor originally sets all PEP code bits (including the two flags) to all 1's then the BED encoder replaces the 1's with the calculated polynomial error code of the block. The two PEP flags remain 1's. The BED decoder at the receiving end, on detecting an error-free PEP code, resets bit 1177 or 4777.

7.15.3 DATA MONITORING PROCEDURES

Generally, telemetry equipment is of greater value in monitoring blocks which have a data rate near the maximum allowed by the HSD line. All but the MSFTP-2 decom have a burst mode available which is especially valuable in monitoring minimum delay data. To effectively monitor DDPS blocks, the telemetry operator should be familiar with the appropriate section (21, 21A, 21B, 21C) of STDN No 502.5 applicable to the current phase and level of DDPS. Section 5 of the applicable NOSP describes the packing of telemetry data within DDPS blocks for each format used in support.

7.15.4 DATA MONITORING EQUIPMENT

7.15.4.1 Monitor 400 Decom

a. Since the primary purpose of the Monitor 400 decom is to monitor and check out SRT data, this is the unit which will be the most commonly available. Because of its availability and burst mode capability, this decom will be the most useful for event-to-event monitoring of DDPS telemetry data. It can be used to read out individual telemetry data bytes in formats of up to 20 blocks.

b. Table 7-5 lists the normal front-panel control settings recommended. Connections to be made on card A3A12 are as follows:

From	To
12	20
13	21
25	27
30	04
31	05
32	06
33	07
34	08

Table 7-5. Monitor 400 Decom Front-panel Setup

Unit/Function	Indication/Setting
BIT SYNC SOURCE	As required
NRZ-L/-M/-S	L
LOOP BW	Wide
DECOM SOURCE	As required
NORM/INVT	As required
LINE FORMAT ID	A
COMPUTER INHB	On
DISPLAY 1 ID	A
DISPLAY 2 ID	A
DISPLAY 3 ID	A
BURST/OFF	BURST
LP-1/LP-2	LP-1

Figures 7-14 and 7-15 illustrate the format patchboard patching for 1200- and 4800-bit blocks, respectively. The following methods are available for inputting data to the decom:

(1) Through the bit sync which is configured for a bit rate of 7.2 kb/sec.

(2) Patching the outputs of the Data Transmission Units (DTU) to one or more of the decom inputs through the level shifters on card A2A30. This is recommended due to the widespread use of 9.6- and 56-kb/sec lines.

c. The format patching and switch settings included in this section use subframe synchronizer A, although synchronizer B may be used by making the appropriate patching and switch selection changes. Selected capabilities are as follows:

(1) The line format ID display will display the octal NASCOM data format. Refer to the Data Characteristics Table in section 1 of the applicable NOSP (NDF column).

(2) To display header information and telemetry data for one-block formats, the MF/SF switch should be set to MF. The frame ID count patching on the format patchboard is not applicable.

(3) To monitor telemetry data bytes in multiple block formats, patch the frame ID count equal to the highest BSC. Set the MF/SF switch to SF and the BSC of the block which contains the byte in the FRAME thumbwheels.

(4) Set the word number for the desired byte in the WORD thumbwheels (see figure 7-12 or 7-13). Refer to ME-2650 for additional operating instructions.

7.15.4.2 MSFTP-2 Decom. The MSFTP-2 decom is useful for monitoring blocks in which the data rate is near the maximum capability of the line. The decom does not have a burst mode, however, and is not satisfactory for low data rates. The program used for monitoring blocks is NASTE. Refer to STDN No. 515.1 for operating instructions and readout locations.

7.15.4.3 MSFTP-2 Simulator. The MSFTP-2 simulator may be used to generate blocks with a number of different characteristics which may be used to check out monitoring equipment. The program used for generating blocks is NASTE SIM. Refer to STDN No. 515.1 for operating instructions.

7.15.4.4 MSFTP-3 Decom. The MSFTP-3 decom is useful for monitoring data contents of one-block formats. With the burst mode and external bit sync clock input capabilities, it is the best unit for monitoring data with low bit rates. The decom can also print selected header information from ID blocks, summary blocks, and blocks with one or more flags set. BOEING is the program used for monitoring 1200-/4800-bit blocks. Refer to STDN No. 515.4 for operating instructions.

7.15.4.5 403 Frame Sync. The 403 frame sync is useful for monitoring one-block formats in which the data rate is near the maximum of the line. Tables 7-6 through 7-9 list the programming instructions for 1200- and 4800-bit blocks divided into 8- and 16-bit words. Table 7-10 lists the front-panel control

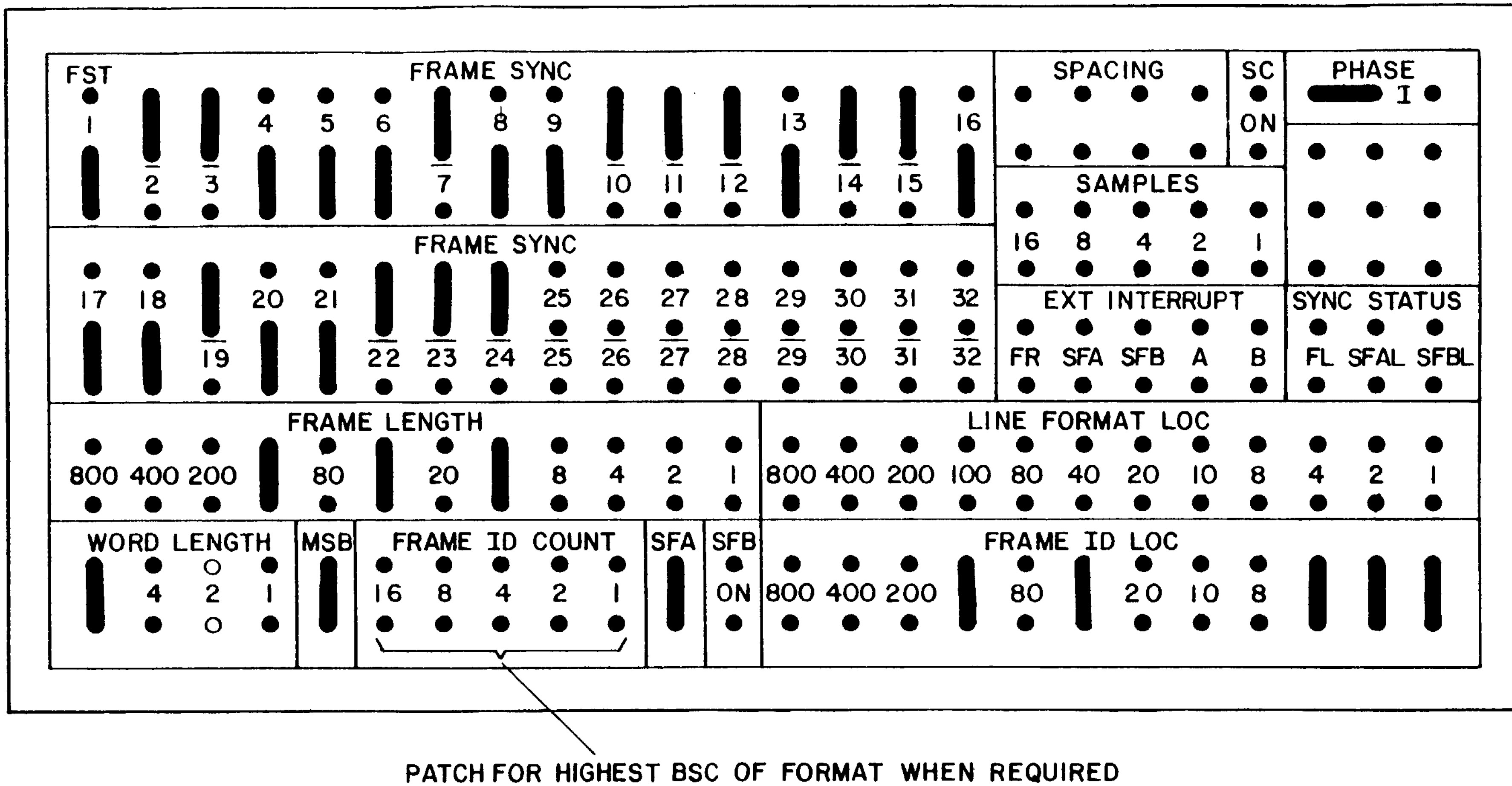


Figure 7-14. Format Patching for 1200-bit DDPS Blocks (Monitor 400 Decom Patchboard)

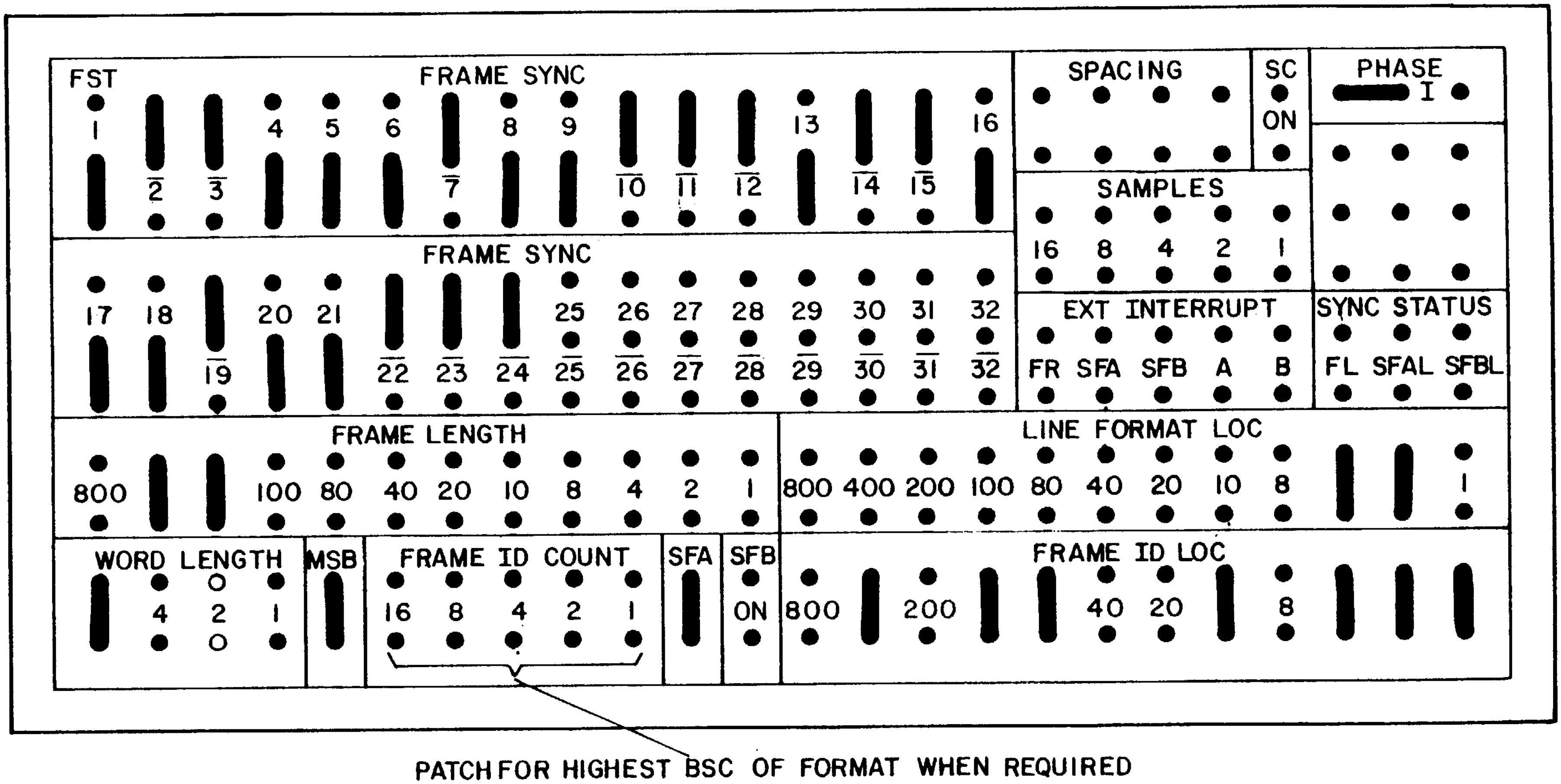


Figure 7-15. Format Patching for 4800-bit DDPS Blocks
(Monitor 400 Decom Patchboard)

settings for the 330 bit sync. See figures 7-10 through 7-13 for the word numbers used to read out words from the blocks. Because the frame sync instructions listed do not enable automatic polarity correction, the bit sync POLARITY switch may have to be sent to acquire frame sync lock.

Table 7-6. 403 Frame Synchronizer Program Instructions for 1200-bit Blocks Divided into 16-bit Words

Unit Address	Function Address				Instruction Bits							
Not used	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	1	0	1	1	0	0	0	1	0
	0	0	1	0	0	1	1	1	0	1	1	0
	0	0	1	1	0	0	1	0	0	1	1	1
	0	1	0	0	0	0	0	0	0	0	0	0
	0	1	0	1	1	1	1	1	1	1	1	1
	0	1	1	0	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	1	1	1	1	1	1
	1	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	0	0	1	1	0	0	0
	1	0	1	0	0	0	0	0	0	0	0	0
	1	0	1	1	0	0	0	0	0	1	0	0
	1	1	0	0	1	0	1	1	0	0	0	0
	1	1	0	1	1	0	0	0	0	0	0	0
	1	1	1	0	0	0	0	1*	0	0	0	0
	1	1	1	1	0	0	0	0	0	0	0	0

* This programs the frame sync to input data from bit sync No. 1. To input data from bit sync No. 2, change instruction 14 bit 4 from 1 to 0.

Table 7-7. 403 Frame Synchronizer Program Instructions for 4800-bit Blocks Divided into 16-bit Words

Unit Address	Function Address				Instruction Bits							
Not used	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	1	0	1	1	0	0	0	1	0
	0	0	1	0	0	1	1	1	0	1	1	0
	0	0	1	1	0	0	1	0	0	1	1	1
	0	1	0	0	0	0	0	0	0	0	0	0
	0	1	0	1	1	1	1	1	1	1	1	1
	0	1	1	0	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	1	1	1	1	1	1
	1	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	0	0	1	1	0	0	0
	1	0	1	0	0	0	0	0	0	0	0	0
	1	0	1	1	0	0	0	1	0	0	1	0
	1	1	0	0	0	1	1	0	0	0	0	0
	1	1	0	1	1	0	0	0	0	0	0	0
	1	1	1	0	0	0	0	1*	0	0	0	0
	1	1	1	1	0	0	0	0	0	0	0	0

*This programs the frame sync to input data from bit sync No. 1. To input data from bit sync No. 2, change instruction 14 bit 4 from 1 to 0.

Table 7-8. 403 Frame Synchronizer Program Instructions for 1200-bit Blocks Divided into 8-bit Words

Unit Address	Function Address				Instruction Bits							
Not used	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	1	0	1	1	0	0	0	1	0
	0	0	1	0	0	1	1	1	0	1	1	0
	0	0	1	1	0	0	1	0	0	1	1	1
	0	1	0	0	0	0	0	0	0	0	0	0
	0	1	0	1	1	1	1	1	1	1	1	1
	0	1	1	0	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	1	1	1	1	1	1
	1	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	0	0	1	1	0	0	0
	1	0	1	0	0	1	0	0	0	0	0	0
	1	0	1	1	0	0	0	0	0	1	0	0
	1	1	0	0	1	0	1	1	0	0	0	0
	1	1	0	1	1	0	0	0	0	0	0	0
	1	1	1	0	0	0	0	1*	0	0	0	0
	1	1	1	1	0	0	0	0	0	0	0	0

*This programs the frame sync to input data from bit sync No. 1. To input data from bit sync No. 2, change instruction 14 bit 4 from 1 to 0.

Table 7-9. 403 Frame Synchronizer Program Instructions for 4800-bit Blocks Divided into 8-bit Words

Unit Address	Function Address				Instruction Bits							
Not used	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	1	0	1	1	0	0	0	1	0
	0	0	1	0	0	1	1	1	0	1	1	0
	0	0	1	1	0	0	1	0	0	1	1	1
	0	1	0	0	0	0	0	0	0	0	0	0
	0	1	0	1	1	1	1	1	1	1	1	1
	0	1	1	0	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	1	1	1	1	1	1
	1	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	0	0	1	1	0	0	0
	1	0	1	0	0	1	0	0	0	0	0	0
	1	0	1	1	0	0	0	1	0	0	1	0
	1	1	0	0	1	1	0	0	0	0	0	0
	1	1	0	1	1	0	0	0	0	0	0	0
	1	1	1	0	0	0	0	1*	0	0	0	0
	1	1	1	1	0	0	0	0	0	0	0	0

*This programs the frame sync to input data from bit sync No. 1. To input data from bit sync No. 2, change instruction 14 bit 4 from 1 to 0.

Table 7-10. 330 Bit Synchronizer Setup

Unit/Function	Indication/Setting
BIT RATE	Set to modem frequency
CODE TYPE	NRZ-L
X2/X3	N/A
POLARITY	As required (Refer to note.)

Note

In the 403 frame sync instructions, automatic polarity correction is not enabled. Set the POLARITY switch as required to obtain lock.

APPENDIX A. STANDARD IRIG SUBCARRIER CHANNELS

APPENDIX A. STANDARD IRIG SUBCARRIER CHANNELS

Tables A-1 and A-2 list the Interrange Instrumentation Group (IRIG) subcarrier standards for constant and proportional bandwidth deviation. This information was extracted from IRIG standards document 106-69.

Table A-1. Constant Bandwidth Subcarrier Channels

A CHANNELS		B CHANNELS		C CHANNELS	
Deviation limits = ±2 kHz Nominal frequency response = 0.4 kHz Maximum frequency response = 2 kHz**		Deviation limits = ±4 kHz Nominal frequency response = 0.8 kHz Maximum frequency response = 4 kHz**		Deviation limits = ±8 kHz Nominal frequency response = 1.6 kHz Maximum frequency response = 8 kHz	
Channel	Center Frequency (kHz)	Channel	Center Frequency (kHz)	Channel	Center Frequency (kHz)
1A	16				
2A	24				
3A	32	3B	32		
4A	40				
5A	48	5B	48		
6A	56				
7A	64	7B	64	7C	64
8A	72				
9A	80	9B	80		
10A	88				
11A	96	11B	96	11C	96
12A	104				
13A	112	13B	112		
14A	120				
15A	128	15B	128	15C	128
16A*	136				
17A*	144	17B*	144		
18A*	152				
19A*	160	19B*	160	19C*	160
20A*	168				
21A*	176	21B*	176		

* Recommended for use in UHF transmission systems only.

** The indicated maximum frequency response is based upon the maximum theoretical response that can be obtained in a bandwidth between deviation limits specified for the channel.

Table A-2. Proportional Bandwidth Subcarrier Channels

Channel	Center Frequency (Hz)	Lower Limit* (Hz)	Upper Limit* (Hz)	Percent of Maximum Deviation	Frequency Response** (Hz)	Omit Channel
1	400	370	430	±7.5	6.0	
2	560	518	602	±7.5	8.4	
3	730	675	785	±7.5	11	
4	960	888	1,032	±7.5	14	
5	1,300	1,202	1,399	±7.5	20	
6	1,700	1,572	1,828	±7.5	25	
7	2,300	2,127	2,473	±7.5	35	
8	3,000	2,775	3,225	±7.5	45	
9	3,900	3,607	4,193	±7.5	59	
10	5,400	4,995	5,805	±7.5	81	
11	7,350	6,799	7,901	±7.5	110	
12	10,500	9,712	11,288	±7.5	160	
13	14,500	13,412	15,588	±7.5	220	
14	22,000	20,350	23,650	±7.5	330	
15	30,000	27,750	32,250	±7.5	450	
16	40,000	37,000	43,000	±7.5	600	
17	52,500	48,562	56,438	±7.5	790	
18	70,000	64,750	75,250	±7.5	1,050	
19	93,000	86,025	99,975	±7.5	1,400	
20	124,000	114,700	133,300	±7.5	1,900	
21	165,000	152,625	177,375	±7.5	2,500	
A***	22,000	18,700	25,300	±15	660	13,15, and B
B	30,000	25,500	34,500	±15	900	14, 16, A and C
C	40,000	34,000	46,000	±15	1,200	15, 17, B and D
D	52,500	44,625	60,375	±15	1,600	16, 18, C and E
E	70,000	59,500	80,500	±15	2,100	17, 19, D and F
F	93,000	79,050	106,950	±15	2,800	18, 20, E and G
G	124,000	105,400	142,660	±15	3,700	19, 21, F and H
H	165,000	140,250	189,750	±15	5,000	20 and G

*Rounded off to nearest cycle.

**The frequency response given is based on maximum deviation and a deviation ratio of 5.

***Channels A through H are optional and may be used by omitting the adjacent channels indicated in this table. If a 100-kHz tape speed compensation tone is mixed with these channels, the 93-kHz channel must be omitted and the 124-kHz channel must not be deviated +15 percent. In the process of recording the foregoing subcarriers on magnetic tape at a receiving station, provision may also be made to record a tapespeed-control tone and tape-speed-error compensation signals.

APPENDIX B. NOSP ORGANIZATION

APPENDIX B. NOSP ORGANIZATION

The following is an outline of the organization of the Network Operations Support Plan, section 2.

SECTION 2. TELEMETRY

2.1 GENERAL (Brief summary outline of entire STDN support)

2.2 LAUNCH VEHICLE SUPPORT

2.2.1 GENERAL (Optional table or paragraph)

2.2.2 LINK DESCRIPTION

2.2.3 RECEIVER CONFIGURATION

2.2.4 DECOM/DEMOD/AMQ CONFIGURATION

2.2.4.1 PAM/PDM/Discriminators

2.2.4.2 Signal Conditioner/Bit Synchronizer

2.2.4.3 PCM Decoms

2.2.4.4 PSK Demod

2.2.4.5 AMQ

2.2.5 MIXER CONFIGURATION

2.2.5.1 Magnetic Tape Recorder

2.2.5.2 FM Remoting

2.2.6 RECORDER CONFIGURATION

2.2.6.1 Magnetic Tape Recorder

2.2.6.2 Stripchart Recorders

2.2.6.3 Calibration Procedures

2.2.7 MARK EVENTS

2.2.8 DATA TRANSMISSION

2.2.8.1 FM Remoting

2.2.8.2 High-speed Data

2.2.9 SPECIAL REQUIREMENTS

2.3 SPACECRAFT SUPPORT

2.3.1 GENERAL (Optional table or paragraph)

2.3.2 LINK DESCRIPTION

2.3.3 RECEIVER CONFIGURATION

2.3.4 DECOM/DEMOD/AMQ CONFIGURATION

2.3.4.1 PAM/PDM/Discriminators

2.3.4.2 Signal Conditioners

2.3.4.3 PCM Decoms

2.3.4.4 PSK Demod

2.3.4.5 AMQ

2.3.5 MIXER CONFIGURATION

2.3.5.1 Magnetic Tape Recorder

2.3.5.2 FM Remoting

2.3.6 RECORDER CONFIGURATION

2.3.6.1 Magnetic Tape Recorder

2.3.6.2 Stripchart Recorders

2.3.6.3 Calibration Procedures

2.3.7 QUICK-LOOK DATA

2.3.8 DATA TRANSMISSION

2.3.8.1 FM Remoting

2.3.8.2 High-speed Data

2.3.9 SPECIAL REQUIREMENTS

2.4 REPORTS

APPENDIX C. COMMON MODULATION TYPES

APPENDIX C. COMMON MODULATION TYPES

The following briefly describes types of modulation frequently encountered in the STDN:

a. Amplitude Modulation. Amplitude Modulation (AM) is characterized by modulation, or variation, in the amplitude of a wave. Each component frequency (f) of the transmitted intelligence produces a pair of sideband frequencies at carrier frequency plus (f) and carrier frequency minus (f). In special cases, the carrier may be suppressed, either the lower or upper set of sideband frequencies may be produced by one or more channels of information, and the upper set of sideband frequencies may be produced by one or more other channels of information. The carrier may be transmitted without intelligence-carrying sideband frequencies (AØ). The resulting emission bandwidth is proportional to the highest frequency component of the intelligence transmitted.

b. Frequency Modulation. With Frequency Modulation (FM) the instantaneous frequency of a sine-wave carrier is caused to depart from the carrier frequency by an amount inversely proportional to the instantaneous value of the modulating. frequency.

c. Phase Modulation. Phase Modulation (PM) is modulation in which the angle of a sine-wave carrier is caused to depart from the carrier angle by an amount proportional to the instantaneous value of the modulating frequency.

d. Pulse Modulation. Pulse modulation is unquantized modulation of a pulse train such that the amplitude, duration, position, time, or frequency of occurrence of the pulse is caused to vary in accordance with some impressed signal.

e. Pulse Amplitude Modulation. Pulse Amplitude Modulation (PAM) is modulation in which a wave is caused to control the amplitude of a pulse carrier.

f. Pulse Time Modulation. Pulse Time Modulation (PTM) is modulation in which the values of instantaneous samples of the modulating waves are caused to modulate the time of occurrence of some characteristic of a pulse carrier.

g. Pulse Frequency Modulation. With Pulse Frequency Modulation (PFM) the pulse repetition frequency of the carrier is varied in accordance with the amplitude and frequency of the modulating signal.

h. Pulse Position Modulation. Pulse Position Modulation (PPM) is modulation in which data causes pulse position within the data stream to vary.

i. Pulse Duration Modulation. Pulse Duration Modulation (PDM) is known as Pulse Width Modulation (PWM). Variations in data cause pulse duration times to vary.

j. Pulse Code Modulation. Pulse Code Modulation (PCM) is that form of pulse modulation in which a code is used to represent quantative values of instantaneous samples of signal waves. In PCM telemetry, information is transmitted by means of a code representing a finite number of values of the information at the time of sampling. PCM also refers to a time division multiplex technique in which the modulated variable (amplitude, frequency, phase) assumes one of a predetermined set of discrete levels in each pulse interval, and groups of pulses thus formed are arranged to produce a code. PCM pulse trains may be organized into various format units such as syllables, characters, words, frames, etc. PCM variations are as follows:

(1) PCM, Parallel. A PCM technique in which the pulses are transmitted simultaneously over parallel channels and are usually detected by sampling all received outputs at the same instant.

(2) PCM, Serial. PCM transmission in which a single data channel is used and the pulse code signals are transmitted and received in sequential order.

k. Combination Modulations

(1) FM/AM is amplitude modulation of a carrier by subcarriers which are frequency modulated by information.

(2) FM/FM is frequency modulation of a carrier by subcarriers which are frequency modulated by information.

(3) FM/PM is phase modulation of a carrier by subcarriers which are frequency modulated by information.

(4) PDM/FM is frequency modulation of a carrier by subcarriers which are time duration modulated by information.

(5) PDM/FM/FM is frequency modulation of a carrier by subcarriers which are frequency modulated by pulses which are in turn time duration modulated by information.

(6) PDM/PM is phase modulation of a carrier by pulses which are duration modulated by information.

(7) PCM/FM is frequency modulation of a carrier by pulse code modulated information.

(8) PCM/FM/FM is frequency modulation of a carrier by subcarriers which are frequency modulated by pulse code modulated information.

(9) PCM/PM is phase modulation of a carrier by pulse code modulated information.

The principles illustrated by these examples may be expanded into other combinations where applicable (e.g., PAM/FM).

APPENDIX D. CONVERSION TABLES

Table D-1. Decimal to Percent Full Scale Conversion (8 Bits)

Units

Tens of Units	0	1	2	3	4	5	6	7	8	9
0	0	0	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2
1	3.6	4.0	4.3	4.7	5.1	5.5	5.9	6.3	6.7	7.1
2	7.5	7.9	8.3	8.7	9.1	9.5	9.9	10.3	10.7	11.1
3	11.5	11.9	12.3	12.6	13.0	13.4	13.8	14.2	14.6	15.0
4	15.4	15.8	16.2	16.6	17.0	17.4	17.8	18.2	18.6	19.0
5	19.4	19.8	20.2	20.6	20.9	21.3	21.7	22.1	22.5	22.9
6	23.3	23.7	24.1	24.5	24.9	25.3	25.7	26.1	26.5	26.9
7	27.3	27.7	28.1	28.1	28.9	29.2	29.6	30.0	30.4	30.8
8	31.2	31.6	32.0	32.4	32.8	33.2	33.6	34.0	34.4	34.8
9	35.2	35.6	36.0	36.0	36.8	37.2	37.5	37.9	38.3	38.7
10	39.1	39.5	39.9	40.3	42.7	41.1	41.5	41.9	42.3	42.7
11	43.1	43.5	43.9	44.3	44.7	45.1	45.5	45.8	46.2	46.2
12	47.0	47.4	47.8	48.2	48.6	49.0	49.4	49.8	50.2	50.6
13	51.0	51.4	51.8	52.2	52.6	53.0	53.4	53.8	54.1	54.5
14	54.9	55.3	55.7	56.1	56.5	56.9	57.3	57.7	58.1	58.5
15	58.9	59.3	59.7	60.1	60.5	60.9	61.3	61.7	62.1	62.4
16	62.8	63.2	63.6	64.0	64.4	64.8	65.2	65.6	66.0	66.4
17	66.8	67.2	67.6	68.0	68.4	68.8	69.2	69.6	70.0	70.4
18	70.8	71.1	71.5	71.9	72.3	72.7	73.1	73.5	73.9	74.3
19	74.7	75.1	75.5	75.9	76.3	76.7	77.1	77.5	77.9	78.3
20	78.7	79.1	79.4	79.8	80.2	80.6	81.0	81.4	81.8	81.2
21	82.6	83.0	83.4	83.8	84.2	84.6	85.0	85.4	85.8	86.2
22	86.6	87.0	87.3	87.7	88.1	88.5	88.9	89.3	89.7	90.1
23	90.5	90.9	91.3	91.7	92.1	92.5	92.9	93.3	93.7	94.1
24	94.5	94.9	95.3	95.7	96.0	96.4	96.8	97.2	97.6	98.0
25	98.4	98.8	99.2	99.6	99.9					

Note

0% → 00000001 → 1
100% → 11111110 → 254

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset)

Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%
24	0.00										
25	0.10	55	3.17	85	6.26	115	9.33	145	12.41	175	15.49
26	0.20	56	3.28	86	6.36	116	9.43	146	12.51	176	15.59
27	0.31	57	3.38	87	6.46	117	9.54	147	12.61	177	15.69
28	0.41	58	3.49	88	6.56	118	9.64	148	12.72	178	15.79
29	0.51	59	3.59	89	6.66	119	9.74	149	12.82	179	15.90
30	0.61	60	3.70	90	6.77	120	9.85	150	12.92	180	16.00
31	0.72	61	3.80	91	6.87	121	9.95	151	13.02	181	16.10
32	0.82	62	3.90	92	6.97	122	10.05	152	13.13	182	16.20
33	0.92	63	4.00	93	7.08	123	10.15	153	13.23	183	16.31
34	1.02	64	4.10	94	7.18	124	10.26	154	13.33	184	16.41
35	1.12	65	4.20	95	7.28	125	10.36	155	13.43	185	16.51
36	1.23	66	4.31	96	7.38	126	10.46	156	13.54	186	16.61
37	1.33	67	4.41	97	7.49	127	10.56	157	13.64	187	16.72
38	1.43	68	4.51	98	7.59	128	10.66	158	13.74	188	16.82
39	1.54	69	4.61	99	7.69	129	10.77	159	13.85	189	16.92
40	1.64	70	4.72	100	7.79	130	10.87	160	13.95	190	17.02
41	1.74	71	4.82	101	7.90	131	10.97	161	14.05	191	17.13
42	1.85	72	4.92	102	8.00	132	11.08	162	14.15	192	17.23
43	1.95	73	5.02	103	8.10	133	11.18	163	14.26	193	17.33
44	2.05	74	5.13	104	8.20	134	11.28	164	14.36	194	17.43
45	2.15	75	5.23	105	8.31	135	11.38	165	14.46	195	17.54
46	2.26	76	5.33	106	8.41	136	11.49	166	14.56	196	17.64
47	2.36	77	5.43	107	8.51	137	11.59	167	14.66	197	17.74
48	2.46	78	5.54	108	8.61	138	11.69	168	14.77	198	17.85
49	2.56	79	5.64	109	8.72	139	11.79	169	14.87	199	17.95
50	2.66	80	5.74	110	8.82	140	11.90	170	14.97	200	18.05
51	2.77	81	5.85	111	8.92	141	12.00	171	15.08	201	18.15
52	2.87	82	5.95	112	9.02	142	12.10	172	15.18	202	18.26
53	2.97	83	6.05	113	9.13	143	12.20	173	15.28	203	18.36
54	3.08	84	6.15	114	9.23	144	12.31	174	15.38	204	18.46

Note

0% ⟶ 0000011000 ⟶ 24
100% ⟶ 1111100111 ⟶ 999

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset) (cont)

Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%
205	18.56	235	21.64	265	24.72	295	27.79	325	30.87	355	33.95
206	18.66	236	21.74	266	24.82	296	27.90	326	30.97	356	34.05
207	18.77	237	21.85	267	24.92	297	28.00	327	31.08	357	34.15
208	18.87	238	21.95	268	25.02	298	28.10	328	31.18	358	34.26
209	18.97	239	22.05	269	25.13	299	28.20	329	31.28	359	34.36
210	19.08	240	22.15	270	25.23	300	28.31	330	31.38	360	34.46
211	19.18	241	22.26	271	25.33	301	28.41	331	31.49	361	34.56
212	19.28	242	22.36	272	25.44	302	28.51	332	31.59	362	34.67
213	19.38	243	22.46	273	25.54	303	28.61	333	31.69	363	34.77
214	19.49	244	22.56	274	25.64	304	28.72	334	31.79	364	34.87
215	19.59	245	22.66	275	25.74	305	28.82	335	31.90	365	34.97
216	19.69	246	22.77	276	25.85	306	28.92	336	32.00	366	35.08
217	19.79	247	22.87	277	25.95	307	29.02	337	32.10	367	35.18
218	19.90	248	22.97	278	26.05	308	29.13	338	32.20	368	35.28
219	20.00	249	23.08	279	26.15	309	29.23	339	32.31	369	35.38
220	20.10	250	23.18	280	26.26	310	29.33	340	32.41	370	35.49
221	20.20	251	23.28	281	26.36	311	29.43	341	32.51	371	35.59
222	20.31	252	23.38	282	26.46	312	29.54	342	32.61	372	35.69
223	20.41	253	23.49	283	26.56	313	29.64	343	32.72	373	35.79
224	20.51	254	23.59	284	26.67	314	29.74	344	32.82	374	35.90
225	20.61	255	23.70	285	26.77	315	29.85	345	32.92	375	36.00
226	20.72	256	23.80	286	26.87	316	29.95	346	33.02	376	36.10
227	20.82	257	23.90	287	26.97	317	30.05	347	33.13	377	36.20
228	20.92	258	24.00	288	27.08	318	30.15	348	33.23	378	36.31
229	21.02	259	24.10	289	27.18	319	30.26	349	33.33	379	36.41
230	21.13	260	24.20	290	27.28	320	30.36	350	33.43	380	36.51
231	21.23	261	24.31	291	27.38	321	30.46	351	33.54	381	36.61
232	21.33	262	24.41	292	27.49	322	30.56	352	33.64	382	36.72
233	21.43	263	24.51	293	27.59	323	30.67	353	33.74	383	36.82
234	21.53	264	24.61	294	27.69	324	30.77	354	33.85	384	36.92

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset) (cont)

Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%
385	37.02	415	40.10	445	43.18	475	46.26	505	49.33	535	52.41
386	37.13	416	40.20	446	43.28	476	46.36	506	49.43	536	52.51
387	37.23	417	40.31	447	43.38	477	46.46	507	49.54	537	52.61
388	37.33	418	40.41	448	43.49	478	46.56	508	49.64	538	52.72
389	37.43	419	40.51	449	43.59	479	46.67	509	49.74	539	52.82
390	37.54	420	40.61	450	43.69	480	46.77	510	49.85	540	52.92
391	37.64	421	40.72	451	43.79	481	46.87	511	49.95	541	53.02
392	37.74	422	40.82	452	43.90	482	46.97	512	50.05	542	53.13
393	37.85	423	40.92	453	44.00	483	47.08	513	50.15	543	53.23
394	37.95	424	41.02	454	44.10	484	47.18	514	50.26	544	53.33
395	38.05	425	41.13	455	44.20	485	47.28	515	50.36	545	53.43
396	38.15	426	41.23	456	44.30	486	47.38	516	50.46	546	53.54
397	38.26	427	41.33	457	44.41	487	47.48	517	50.56	547	53.64
398	38.36	428	41.43	458	44.51	488	47.59	518	50.67	548	53.74
399	38.46	429	41.54	459	44.61	489	47.69	519	50.77	549	53.85
400	38.56	430	41.64	460	44.72	490	47.79	520	50.87	550	53.95
401	38.67	431	41.74	461	44.82	491	47.90	521	50.97	551	54.05
402	38.77	432	41.85	462	44.92	492	48.00	522	51.08	552	54.15
403	38.87	433	41.95	463	45.02	493	48.10	523	51.18	553	54.26
404	38.97	434	42.05	464	45.13	494	48.20	524	51.28	554	54.36
405	39.08	435	42.15	465	45.23	495	48.30	525	51.38	555	54.46
406	39.18	436	42.26	466	45.33	496	48.41	526	51.49	556	54.56
407	39.28	437	42.36	467	45.43	497	48.51	527	51.59	557	54.67
408	39.38	438	42.46	468	45.54	498	48.61	528	51.69	558	54.77
409	39.49	439	42.56	469	45.64	499	48.72	529	51.79	559	54.87
410	39.59	440	42.67	470	45.74	500	48.82	530	51.90	560	54.97
411	39.69	441	42.77	471	45.85	501	48.92	531	52.00	561	55.08
412	39.79	442	42.87	472	45.95	502	49.02	532	52.10	562	55.18
413	39.90	443	42.97	473	46.05	503	49.13	533	52.20	563	55.28
414	40.00	444	43.08	474	46.15	504	49.23	534	52.31	564	55.38

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset) (cont)

Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%
565	55.49	595	58.56	625	61.64	655	64.72	685	67.79	715	70.87
566	55.59	596	58.67	626	61.74	656	64.82	686	67.90	716	70.97
567	55.69	597	58.77	627	61.85	657	64.92	687	68.00	717	71.08
568	55.79	598	58.87	628	61.95	658	65.03	688	68.10	718	71.18
569	55.90	599	58.97	629	62.05	659	65.13	689	68.20	719	71.28
570	56.00	600	59.08	630	62.15	660	65.23	690	68.31	720	71.38
571	56.10	601	59.18	631	62.26	661	65.33	691	68.41	721	71.49
572	56.20	602	59.28	632	62.36	662	65.43	692	68.51	722	71.59
573	56.31	603	59.38	633	62.46	663	65.54	693	68.61	723	71.69
574	56.41	604	59.49	634	62.56	664	65.64	694	68.72	724	71.79
575	56.51	605	59.59	635	62.67	665	65.74	695	68.82	725	71.90
576	56.61	606	59.69	636	62.77	666	65.85	696	68.92	726	72.00
577	56.72	607	59.79	637	62.87	667	65.95	697	69.02	727	72.10
578	56.82	608	59.90	638	62.97	668	66.05	698	69.13	728	72.20
579	56.92	609	60.00	639	63.08	669	66.15	699	69.23	729	72.31
580	57.02	610	60.10	640	63.18	670	66.26	700	69.33	730	72.41
581	57.13	611	60.20	641	63.28	671	66.36	701	69.43	731	72.51
582	57.23	612	60.30	642	63.38	672	66.46	702	69.54	732	72.61
583	57.33	613	60.41	643	63.49	673	66.56	703	69.64	733	72.72
584	57.43	614	60.51	644	63.59	674	66.67	704	69.74	734	72.82
585	57.54	615	60.61	645	63.69	675	66.77	705	69.85	735	72.92
586	57.64	616	60.72	646	63.79	676	66.87	706	69.95	736	73.02
587	57.74	617	60.82	647	63.90	677	66.97	707	70.05	937	73.13
588	57.85	618	60.92	648	64.00	678	67.08	708	70.15	738	73.23
589	57.95	619	61.02	649	64.10	679	67.18	709	70.26	739	73.33
590	58.05	620	61.13	650	64.21	680	67.28	710	70.36	740	73.43
591	58.15	621	61.23	651	64.31	681	67.38	711	70.46	741	73.54
592	58.26	622	61.33	652	64.41	682	67.49	712	70.56	742	73.64
593	58.36	623	61.43	653	64.51	683	67.59	713	70.67	743	73.74
594	58.46	624	61.54	654	64.61	684	67.69	714	70.77	744	73.85

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset) (cont)

Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%	Dec	FS%
745	73.95	775	77.02	805	80.10	835	83.18	865	86.26	895	89.33
746	74.05	776	77.13	806	80.20	836	83.28	866	86.36	896	89.43
747	74.15	777	77.23	807	80.31	837	83.38	867	86.46	897	89.54
748	74.26	778	77.33	808	80.41	838	83.49	868	86.56	898	89.64
749	74.36	779	77.43	809	80.51	839	83.59	869	86.67	899	89.74
750	74.46	780	77.54	810	80.61	840	83.69	870	86.77	900	89.85
751	74.56	781	77.64	811	80.72	841	83.79	871	86.87	901	89.95
752	74.67	782	77.74	812	80.82	842	83.90	872	86.97	902	90.05
753	74.77	783	77.85	813	80.92	843	84.00	873	87.08	903	90.15
754	74.87	784	77.95	814	81.02	844	84.10	874	87.18	904	90.26
755	74.97	785	78.05	815	81.13	845	84.20	875	87.28	905	90.36
756	75.08	786	78.15	816	81.23	846	84.31	876	87.38	906	90.46
757	75.18	787	78.26	817	81.33	847	84.41	877	87.49	907	90.56
758	75.28	788	78.36	818	81.43	848	84.51	878	87.59	908	90.67
759	75.38	789	78.46	819	81.54	849	84.61	879	87.69	909	90.77
760	75.49	790	78.56	820	81.64	850	84.72	880	87.79	910	90.87
761	75.59	791	78.67	821	81.74	851	84.82	881	87.89	911	90.97
762	75.69	792	78.77	822	81.85	852	84.92	882	88.00	912	91.08
763	75.79	793	78.87	823	81.95	853	85.02	883	88.10	913	91.18
764	75.90	794	78.97	824	82.05	854	85.13	884	88.20	914	91.28
765	76.00	795	79.08	825	82.15	855	85.23	885	88.31	915	91.38
766	76.10	796	79.18	826	82.26	856	85.33	886	88.41	916	91.49
767	76.20	797	79.28	827	82.36	857	85.43	887	88.51	917	91.59
768	76.31	798	79.38	828	82.46	858	85.54	888	88.61	918	91.69
769	76.41	799	79.49	829	82.56	859	85.64	889	88.72	919	91.79
770	76.51	800	79.59	830	82.67	860	85.74	890	88.82	920	91.90
771	76.61	801	79.69	831	82.77	861	85.85	891	88.92	921	92.00
772	76.72	802	79.79	832	82.87	862	85.95	892	89.02	922	92.10
773	76.82	803	79.90	833	82.97	863	86.05	893	89.13	923	92.20
774	76.92	804	80.00	834	83.08	864	86.15	894	89.23	924	92.31

Table D-2. Decimal to Percent Full Scale Conversion (10 Bits and Offset) (cont)

Dec	FS%	Dec	FS%	Dec	FS%
925	92.41	955	95.49	985	98.56
926	92.51	956	95.59	986	98.67
927	92.61	957	95.69	987	98.77
928	92.72	958	95.79	988	98.87
929	92.82	959	95.90	989	98.97
930	92.92	960	96.00	990	99.08
931	93.02	961	96.10	991	99.18
932	93.13	962	96.20	992	99.28
933	93.23	963	96.31	993	99.38
934	93.33	964	96.41	994	99.49
935	93.43	965	96.51	995	99.59
936	93.54	966	96.61	996	99.69
937	93.64	967	96.72	997	99.79
938	93.74	968	96.82	998	99.99
939	93.85	969	96.92	999	100.00
940	93.95	970	97.02		
941	94.05	971	97.13		
942	94.15	972	97.23		
943	94.26	973	97.33		
944	94.36	974	97.43		
945	94.46	975	97.54		
946	94.56	976	97.64		
947	94.67	977	97.74		
948	94.77	978	97.85		
949	94.87	979	97.95		
950	94.97	980	98.05		
951	95.08	981	98.15		
952	95.18	982	98.26		
953	95.28	983	98.36		
954	95.38	984	98.46		

Table D-3. Octal/Decimal Conversion Chart

Octal Value	Dec.	%	Octal Value	Dec.	%	Octal Value	Dec.	%	Octal Value	Dec.	%	Octal Value	Dec	%
000	0	??.?	025	21	07.9	052	42	16.2	077	63	24.5	124	84	32.8
001	1	00.0	026	22	08.3	053	43	16.6	100	64	24.9	125	85	33.2
002	2	00.4	027	23	08.7	054	44	17.0	101	65	25.3	126	86	33.6
003	3	00.8	030	24	09.1	055	45	17.4	102	66	25.7	127	87	34.0
004	4	01.2	031	25	09.5	056	46	17.8	103	67	26.1	130	88	34.4
005	5	01.6	032	26	09.9	057	47	18.2	104	68	26.5	131	89	34.8
006	6	02.0	033	27	10.3	060	48	18.6	105	69	26.9	132	90	35.2
007	7	02.4	034	28	10.7	061	49	19.0	106	70	27.3	133	91	35.6
010	8	02.8	035	29	11.1	062	50	19.4	107	71	27.7	134	92	36.0
011	9	03.2	036	30	11.5	063	51	19.8	110	72	28.1	135	93	36.4
012	10	03.6	037	31	11.9	064	52	20.2	111	73	28.5	136	94	36.8
013	11	04.0	040	32	12.3	065	53	20.6	112	74	28.9	137	95	37.2
014	12	04.3	041	33	12.6	066	54	20.9	113	75	29.2	140	96	37.5
015	13	04.7	042	34	13.0	067	55	21.3	114	76	29.6	141	97	37.9
016	14	05.1	043	35	13.4	070	56	21.7	115	77	30.0	142	98	38.3
017	15	05.5	044	36	13.8	071	57	22.1	116	78	30.4	143	99	38.7
020	16	05.9	045	37	14.2	072	58	22.5	117	79	30.8	144	100	39.1
021	17	06.3	046	38	14.6	073	59	22.9	120	80	31.2	145	101	39.5
022	18	06.7	047	39	15.0	074	60	23.3	121	81	31.6	146	102	39.9
023	19	07.1	050	40	15.4	075	61	23.7	122	82	32.0	147	103	40.3
024	20	07.5	051	41	15.8	076	62	24.1	123	83	32.4	150	104	40.7

Table D-3. Octal/Decimal Conversion Chart (cont)

Octal Value	Dec	%	Octal Value	Dec.	%	Octal Value	Dec.	%	Octal Value	Dec	%	Octal Value	Dec.	%
151	105	41.1	176	126	49.4	223	147	57.7	250	168	66.0	275	189	74.3
152	106	41.5	177	127	49.8	224	148	58.1	251	169	66.4	276	190	74.7
153	107	41.9	200	128	50.2	225	149	58.5	252	170	66.8	277	191	75.1
154	108	42.3	201	129	50.6	226	150	58.9	253	171	67.2	300	192	75.5
155	109	42.7	202	130	51.0	227	151	59.3	254	172	67.6	301	193	75.9
156	110	43.1	203	131	51.4	230	152	59.7	255	173	68.0	302	194	76.3
157	111	43.5	204	132	51.8	231	153	60.1	256	174	68.4	303	195	76.7
160	112	43.9	205	133	52.2	232	154	60.5	257	175	68.8	304	196	77.1
161	113	44.3	206	134	52.6	233	155	60.9	260	176	69.2	305	197	77.5
162	114	44.7	207	135	53.0	234	156	61.3	261	177	69.6	306	198	77.9
163	115	45.1	210	136	53.4	235	157	61.7	262	178	70.0	307	199	78.3
164	116	45.5	211	137	53.8	236	158	62.1	263	179	70.4	310	200	78.7
165	117	45.8	212	138	54.1	237	159	62.4	264	180	70.8	311	201	79.1
166	118	46.2	213	139	54.5	240	160	62.8	265	181	71.1	312	202	79.4
167	119	46.6	214	140	54.9	241	161	63.2	266	182	71.5	313	203	79.8
170	120	47.0	215	141	55.3	242	162	63.6	267	183	71.9	314	204	80.2
171	121	47.4	216	142	55.7	243	163	64.0	270	184	72.3	315	205	80.6
172	122	47.8	217	143	56.1	244	164	64.4	271	185	72.7	316	206	81.0
173	123	48.2	220	144	56.5	245	165	64.8	272	186	73.1	317	207	81.4
174	124	48.6	221	145	56.9	246	166	65.2	273	187	73.5	320	208	81.8
175	125	49.0	222	146	57.3	247	167	65.6	274	188	73.9	321	209	82.2

Table D-3. Octal/Decimal Conversion Chart (cont)

Octal Value	Dec.	%	Octal Value	Dec	%	Octal Value	Dec.	%
322	210	82.6	347	231	90.9	374	252	99.2
323	211	83.0	350	232	91.3	375	253	99.6
324	212	83.4	351	233	91.7	376	254	99.9
325	213	83.8	352	234	92.1	377	255	$$.$
326	214	84.2	353	235	92.5			
327	215	84.6	354	236	92.9			
330	216	85.0	355	237	93.3			
331	217	85.4	356	238	93.7			
332	218	85.8	357	239	94.1			
333	219	86.2	360	240	94.5			
334	220	86.6	361	241	94.9			
335	221	87.0	362	242	95.3			
336	222	87.3	363	243	95.7			
337	223	87.7	364	244	96.0			
340	224	88.1	365	245	96.4			
341	225	88.5	366	246	96.8			
342	226	88.9	367	247	97.2			
343	227	89.3	370	248	97.6			
344	228	89.7	371	249	98.0			
345	229	90.1	372	250	98.4			
346	230	90.5	373	251	98.8			

APPENDIX E. TO BE SUPPLIED

APPENDIX E. To be supplied.

APPENDIX F. MSFTP-2/642B COMPUTER BUFFER PATCHING INSTRUCTIONS

Table F-1. MSFTP-2 Buffer Patching Instructions (DDPS Normal Mode)

MSFTP-2 Patch From	To	Function	Computer Buffer Bit
A	EL	PCM Bit 1	2^{0}
B	EK	2	2^{1}
C	EJ	3	2^{2}
D	EH	4	2^{3}
E	EF	5	2^{4}
F	EE	6	2^{5}
H	ED	7	2^{6}
J	EC	8	2^{7}
K	EB	9	2^{8}
L	EA	10	2^{9}
M	DZ	11	2^{10}
N	DY	12	2^{11}
P	DX	13	2^{12}
R	DW	14	2^{13}
S	DV	15	2^{14}
T	DU	PCM Bit 16	2^{15}
Open		0	2^{16}
Open		0	2^{17}
Open		0	2^{18}
Open		0	2^{19}
AX	DN	Tape Playback No. 1	2^{20}
BZ	DM	Format ID 2^{0}	2^{21}
AK	DL	Format ID 2^{1}	2^{22}
AL	DK	Format ID 2^{2}	2^{23}
AM	DJ	Format ID 2^{3}	2^{24}
AN	DH	Format ID 2^{4}	2^{25}
CH	DF	Bit Slippage	2^{26}
CC	DE	Frame Sync 3 Error	2^{27}
CF	DD	Imperfect Frame Sync	2^{28}
AV	DC	Abnormal Bit	2^{29}
CA	CV	Abnormal Interrupt	

Table F-2. MSFTP-2 Buffer Patching Instructions (Standard 22-bit Transfer)

MSFTP-2 From	To	Function		Computer Buffer Bit
A	EL	PCM bit	0	2^0
B	EK		1	2^1
C	EJ		2	2^2
D	EH		3	2^3
E	EF		4	2^4
F	EE		5	2^5
H	ED		6	2^6
J	EC		7	2^7
K	EB		8	2^8
L	EA		9	2^9
M	DZ		10	2^{10}
N	DY		11	2^{11}
P	DX		12	2^{12}
R	DW		13	2^{13}
S	DV		14	2^{14}
T	DU		15	2^{15}
U	DT		16	2^{16}
V	DS		17	2^{17}
W	DR		18	2^{18}
X	DP		19	2^{19}
Y	DN		20	2^{20}
Z	DM	PCM bit	21	2^{21}
CC	DL	Frame Sync Correlation	22	2^{22}
AX	DK	Tape Playback No. 1	23	2^{23}
BZ	DJ	Format ID 2^0	24	2^{24}
AK	DH	Format ID 2^1	25	2^{25}
AL	DF	Format ID 2^2	26	2^{26}
AM	DE	Format ID 2^3	27	2^{27}
AN	DD	Format ID 2^4	28	2^{28}
AV	DC	Abnormal Bit	29	2^{29}
CA	CV	Abnormal Interrupt		---(Internal Patch)

Table F-3. MSFTP-2 Buffer Patching Instructions (Standard 24-bit Transfer)

MSFTP-2

From	To	Function		Computer Buffer Bit
A	EL	PCM bit	0	2^0
B	EK		1	2^1
C	EJ		2	2^2
D	EH		3	2^3
E	EF		4	2^4
F	EE		5	2^5
H	ED		6	2^6
J	EC		7	2^7
K	EB		8	2^8
L	EA		9	2^9
M	DZ		10	2^{10}
N	DY		11	2^{11}
P	DX		12	2^{12}
R	DW		13	2^{13}
S	DV		14	2^{14}
T	DU		15	2^{15}
U	DT		16	2^{16}
V	DS		17	2^{17}
W	DR		18	2^{18}
X	DP		19	2^{19}
Y	DN		20	2^{20}
Z	DM		21	2^{21}
AA	DL		22	2^{22}
AB	DK	PCM bit	23	2^{23}
AX	DJ	Tape Playback No. 1	24	2^{24}
CC	DH	Frame Sync Correlation	25	2^{25}
BZ	DF	Format ID 2^0	26	2^{26}
AK	DE	Format ID 2^1	27	2^{27}
AL	DD	Format ID 2^2	28	2^{28}
AV	DC	Abnormal Bit	29	2^{29}
CA	CV	Abnormal Interrupt		---(Internal Patch)

APPENDIX G. MSFTP-3/642B COMPUTER BUFFER PATCHING INSTRUCTIONS

Table G-1. MSFTP-3 Buffer Patching Instructions (DDPS Transfer)

From Computer Output With IDR	EI	To		Function		Computer Buffer Bit
0	0	Data Register	0	PCM Bit 1		2^0
1	1		1	2		2^1
2	2		2	3		2^2
3	3		3	4		2^3
4	4		4	5		2^4
5	5		5	6		2^5
6	6		6	7		2^6
7	7		7	8		2^7
8	8		8	9		2^8
9	9		9	10		2^9
10	10		10	11		2^{10}
11	11		11	12		2^{11}
12	12		12	13		2^{12}
13	13		13	14		2^{13}
14	14		14	15		2^{14}
15	15	Data Register	15	PCM Bit 16		2^{15}
16	16			Not Defined		2^{16}
17	17			Not Defined		2^{17}
18	18			Not Defined		2^{18}
19	19			Not Defined		2^{19}
20	20	TP1		Tape Playback		2^{20}
21	21	FMT ID	1		2^0	2^{21}
22	22		2		2^1	2^{22}
23	23		4	Format ID	2^2	2^{23}
24	24		8		2^3	2^{24}
25	25		16		2^4	2^{25}
26	26	Bit Slip		Bit Slippage		2^{26}
27	27	FSC		Frame Sync Correlation		2^{27}
28	28	Imperfect Frame Sync		Imperfect Frame Sync		2^{28}
29	29	AB	1	Abnormal Bit		2^{29}
				Abnormal Interrupt		

Table G-2. Intentionally blank.

Table G-3. MSFTP-3 Buffer Patching Instructions (Standard 22-bit Transfer)

From Computer Output With IDR	EI	To	Function			Computer Buffer Bit
0	0	Data Register	0	PCM Bit	0	2^0
1	1	↓	1	↓	1	2^1
2	2		2		2	2^2
3	3		3		3	2^3
4	4		4		4	2^4
5	5		5		5	2^5
6	6		6		6	2^6
7	7		7		7	2^7
8	8		8		8	2^8
9	9		9		9	2^9
10	10		10		10	2^{10}
11	11		11		11	2^{11}
12	12		12		12	2^{12}
13	13		13		13	2^{13}
14	14		14		14	2^{14}
15	15		15		15	2^{15}
16	16		16		16	2^{16}
17	17		17		17	2^{17}
18	18		18		18	2^{18}
19	19		19		19	2^{19}
20	20		20		20	2^{20}
21	21	Data Register	21	PCM Bit	21	2^{21}
22	22		22	Frame Sync Correlation	22	2^{22}
23	23		23	Tape Playback	23	2^{23}
24	24		24	Format ID 2^0	24	2^{24}
25	25		25	Format ID 2^1	25	2^{25}
26	26		26	Format ID 2^2	26	2^{26}
27	27		27	Format ID 2^3	27	2^{27}
28	28		28	Format ID 2^4	28	2^{28}
29	29		29	Abnormal Bit	29	2^{29}

Table G-4. MSFTP-3 Buffer Patching Instructions
(Standard 24-bit Transfer)

From Computer Output With							
IDR	EI	To	Function				Computer Buffer Bit
0	0	Data Register	0	PCM Bit		0	2^{0}
1	1		1			1	2^{1}
2	2		2			2	2^{2}
3	3		3			3	2^{3}
4	4		4			4	2^{4}
5	5		5			5	2^{5}
6	6		6			6	2^{6}
7	7		7			7	2^{7}
8	8		8			8	2^{8}
9	9		9			9	2^{9}
10	10		10			10	2^{10}
11	11		11			11	2^{11}
12	12		12			12	2^{12}
13	13		13			13	2^{13}
14	14		14			14	2^{14}
15	15		15			15	2^{15}
16	16		16			16	2^{16}
17	17		17			17	2^{17}
18	18		18			18	2^{18}
19	19		19			19	2^{19}
20	20		20			20	2^{20}
21	21		21			21	2^{21}
22	22		22			22	2^{22}
23	23	Data Register	23	PCM Bit		23	2^{23}
24	24		24	Tape Playback		24	2^{24}
25	25		25	Frame Sync Correlation		25	2^{25}
26	26		26		2^{0}	26	2^{26}
27	27		27	Format ID	2^{1}	27	2^{27}
28	28		28		2^{2}	28	2^{28}
29	29		29	Abnormal Bit		29	2^{29}

APPENDIX H. DYNATRONICS DHS/642B COMPUTER BUFFER PATCHING INSTRUCTIONS

Table H-1. DHS Buffer Patching Instructions (DDPS Normal Mode)

From	To	PCM Data Bit[1]	Computer Buffer Bit
A24	B24	1	2^0
A23	B23	2	2^1
A22	B22	3	2^2
A21	B21	4	2^3
A20	B20	5	2^4
A19	B19	6	2^5
A18	B18	7	2^6
A17	B17	8	2^7
A16	B16	9	2^8
A15	B15	10	2^9
A14	B14	11	2^{10}
A13	B13	12	2^{11}
A12	B12	13	2^{12}
A11	B11	14	2^{13}
A10	B10	15	2^{14}
A9	B9	16	2^{15}
	B8	Not Defined	2^{16}
	B7	Not Defined	2^{17}
	B6	Not Defined	2^{18}
	B5	Not Defined	2^{19}
F15	B4	Tape Playback No. 1	2^{20}
G24	B3	Format ID 2^0	2^{21}
G23	B2	Format ID 2^1	2^{22}
G22	B1	Format ID 2^2	2^{23}
G21	E24	Format ID 2^3	2^{24}
G20	E23	Format ID 2^4	2^{25}

Table H-1. DHS Buffer Patching Instructions (DDPS Normal Mode) (cont)

From	To	PCM Data Bit[1]	Computer Buffer Bit
	E22	(Note 2)	2^{26}
G15	E21	Frame Sync Correlation	2^{27}
	E20	(Note 2)	2^{28}
		Abnormal Bit[3]	2^{29}

Note

1. PCM bit numbering refers to the assembled PCM word. Decom programming determines the LSB/MSB positions. All PCM words are justified on bit 1 regardless of word length.
2. DDPS computer bits 2^{26} and 2^{28} are allocated for bit slippage and imperfect frame sync, respectively.
3. Bit 2^{29} abnormal bit, is a hardwired connection.

Table H-2. DHS Computer Buffer Patching Instructions (DDPS Thruput Mode)

From	To	PCM Data Bit[1]		Computer Buffer Bit
A24	B9	16		2^0
A23	B10	15		2^1
A22	B11	14		2^2
A21	B12	13		2^3
A20	B13	12		2^4
A19	B14	11		2^5
A18	B15	10		2^6
A17	B16	9		2^7
A16	B17	8		2^8
A15	B18	7		2^9
A14	B19	6		2^{10}
A13	B20	5		2^{11}
A12	B21	4		2^{12}
A11	B22	3		2^{13}
A10	B23	2		2^{14}
A9	B24	1		2^{15}
	B8	Not Defined		2^{16}
	B7	Not Defined		2^{17}
	B6	Not Defined		2^{18}
	B5	Not Defined		2^{19}
F15	B4	Tape Playback No. 1		2^{20}
G24	B3	Format ID	2^0	2^{21}
G23	B2	Format ID	2^1	2^{22}
G22	B1	Format ID	2^2	2^{23}
G21	E24	Format ID	2^3	2^{24}
G20	E23	Format ID	2^4	2^{25}

Table H-2. DHS Computer Buffer Patching Instructions (DDPS Thruput Mode) (cont)

From	To	PCM Data Bit[1]	Computer Buffer Bit
	E22	(Note 2)	2^{26}
G15	E21	Frame Sync Correlation	2^{27}
	E20	(Note 2)	2^{28}
		Abnormal Bit[3]	2^{29}

Note

1. PCM bit numbering refers to the assembled PCM word. Decom programming determines the LSB/MSB positions. All PCM words are justified on bit 1 regardless of word length.
2. DDPS computer bits 2^{26} and 2^{28} are allocated for bit slippage and imperfect frame sync, respectively. These signals are not presently available.
3. Bit 2^{29}, abnormal bit, is a hardwired connection.

Table H-3. DHS Buffer Patching Instructions (Standard 22-bit Transfer)

Dynatronics DHS From	To	Function		Computer Buffer Bit
A24	B24	PCM Bit	0	2^0
A23	B23		1	2^1
A22	B22		2	2^2
A21	B21		3	2^3
A20	B20		4	2^4
A19	B19		5	2^5
A18	B18		6	2^6
A17	B17		7	2^7
A16	B16		8	2^8
A15	B15		9	2^9
A14	B14		10	2^{10}
A13	B13		11	2^{11}
A12	B12		12	2^{12}
A11	B11		13	2^{13}
A10	B10		14	2^{14}
A9	B9		15	2^{15}
A8	B8		16	2^{16}
A7	B7		17	2^{17}
A6	B6		18	2^{18}
A5	B5		19	2^{19}
A4	B4		20	2^{20}
A3	B3	PCM Bit	21	2^{21}
G15	B2	Frame Sync Correlation	22	2^{22}
F15	B1	Tape Playback No. 1	23	2^{23}
G24	E24	2^0	24	2^{24}
G23	E23	2^1	25	2^{25}
G22	E22	Format ID 2^2	26	2^{26}
G21	E21	2^3	27	2^{27}
C20	E20	2^4	28	2^{28}
		Abnormal Bit		Hardwire Connections

Table H-4. DHS Buffer Patching Instructions (Standard 24-bit Transfer)

Dynatronics DHS

From	To	Function	Computer Buffer Bit
A24	B24	PCM Bit 0	20^{0}
A23	B23	1	2^{1}
A22	B22	2	2^{2}
A21	B21	3	2^{3}
A20	B20	4	2^{4}
A19	B19	5	2^{5}
A18	B18	6	2^{6}
A17	B17	7	2^{7}
A16	B16	8	2^{8}
A15	B15	9	2^{9}
A14	B14	10	2^{10}
A13	B13	11	2^{11}
A12	B12	12	2^{12}
A11	B11	13	2^{13}
A10	B10	14	2^{14}
A9	B9	15	2^{15}
A8	B8	16	2^{16}
A7	B7	17	2^{17}
A6	B6	18	2^{18}
A5	B5	19	2^{19}
A4	B4	20	2^{20}
A3	B3	21	2^{21}
A2	B2	22	2^{22}
A1	B1	PCM Bit 23	2^{23}

Table H-4. DHS Buffer Patching Instructions (Standard 24-bit Transfer) (cont)

Dynatronics
DHS

From	To	Function			Computer Buffer Bit
E24	F15	Tape Playback No. 1		24	2^{24}
E23	G15	Frame Sync Correlation		25	2^{25}
E22	G24	Format ID	2^0	26	2^{26}
E21	G23	Format ID	2^1	27	2^{27}
E20	G22	Format ID	2^2	28	2^{28}
		Abnormal Bit			Hardwire Connection

Table H-5. DHS Buffer Patching Instructions (DDPS Special 8-bit SCE Transfer)

From	To	PCM Data Bit[1]	Computer Buffer Bit
B24	A17	1	2^{0}
B23	A18	2	2^{1}
B22	A19	3	2^{2}
B21	A20	4	2^{3}
B20	A21	5	2^{4}
B19	A22	6	2^{5}
B18	A23	7	2^{6}
B17	A24	8	2^{7}
Open		9	2^{8}
Open		10	2^{9}
Open		11	2^{10}
Open		12	2^{11}
Open		13	2^{12}
Open		14	2^{13}
Open		15	2^{14}
Open		16	2^{15}
Open		Not Defined	2^{16}
		Not Defined	2^{17}
		Open	2^{18}
		Open	2^{19}
		Open	2^{20}
G24	B3	Format ID 2^{0}	2^{21}
G23	B2	Format ID 2^{1}	2^{22}
G22	B1	Format ID 2^{2}	2^{23}
G21	E24	Format ID 2^{3}	2^{24}
G20	E23	Format ID 2^{4}	2^{25}

Table H-5. DHS Buffer Patching Instructions (DDPS Special 8-bit SCE Transfer) (cont)

From	To	PCM Data Bit[1]	Computer Buffer Bit
G15	E21	(Note 2)	2^{26}
		Frame Sync Correlation	2^{27}
		(Note 2)	2^{28}
		Abnormal Bit[3]	2^{29}

Note

1. PCM Bit numbering refers to the assembled PCM word. Decom programming determines the LSB/MSB positions. All PCM words are justified on bit 1 regardless of word length.
2. DDPS computer bits 2^{26} and 2^{28} are allocated for bit slippage and imperfect frame sync, respectively.
3. Bit 2^{29} abnormal bit, is a hardwired connection.

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